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Worldwide Report

NUCLEAR DEVELOPMENT AND PROLIFERATION

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LI PENG VIEWS NUCLEAR POWER

OW231232 Beijing XINHUA in English 1204 GMT 23 Mar 84

[Text] Beijing, March 23 (XINHUA) -- China plans to master step by step the technology of manufacturing nuclear power plant equipment for the country's own projects, although at present the technology has to be imported, Vice-Premier Li Peng said here today.

He was reporting on China's current economic situation and energy development at a meeting of the Chinese People's Political Consultative Conference which opened here today.

He said China planned to build two nuclear power plants during the Sixth Five-Year Plan (1981-1985) period. Construction has begun on the one in Qinshan, Zhejiang Province. Preparatory work has started on the Guangdong Province plant. Another two will be built during the Seventh Five-Year Plan period (1986-1990), the vice-premier revealed, one in north-east China and one in east China.

"Our policy is to develop nuclear power appropriately," Li Peng said. "We have uranium resources and we have built atom bombs and hydrogen bombs." China has trained a contingent of technical personnel and has set up its own nuclear industry, he added. The country must develop nuclear power but started late. "We must try hard to catch up," he said.

Vice-Premier Li Peng said China is making preparations to set up a national safety supervisory committee and adopt strict protective measures for peaceful utilization of nuclear energy.

CSO: 5100/4119

CONSTRAINTS IN NUCLEAR PLANT BUILDING DISCUSSED

Prague TRIBUNA in Czech Nos 7, 8, 1984

[Article by Engineer Ladislav Namestek, Czechoslovak Atomic Energy Commission: "Do We Have Sites for Power Plants?"]

[No 7, 15 Feb 84 p 17]

[Text] Nuclear power generation entered our subconscious on tiptoes in the late 1950's. But there it gained hold with a persistence that was warranted by the financial somersaults of petroleum, and subsequently of other fuels as well, at the beginning of the energy crisis. In Jaslovske Bohunice there are thus arising two nuclear power plants, with a capacity of 2 x 440 MW. Also the Dukovany construction site was selected under similar circumstances in the Trebic area. The finding that our reserves of solid fuel would tend to become quickly depleted at their present rate of use leads to the setting of a clear policy: power generating capacity will be expanded solely on the basis of nuclear fuel. The soundness of this decision is evident from the fact that a gram of uranium replaces two million grams of coal! From the economist's viewpoint, the logic of this step is obvious. But it is an entirely different question whether we have sufficient sites to build additional nuclear power plants and the necessary related installations.

A new task can no longer be solved with a "case by case" approach, not even if it is combined with a high degree of social responsibility and professionalism. It requires a consistent and systematic approach. Therefore the experience to date is being combined, the requirements are formulated, and on their basis criteria are set with which a site for the construction of nuclear power installations can be evaluated in a uniform manner that is binding for all the interested parties. Here it has been necessary to consider to what extent the criteria for the selection of construction sites are to differ for nuclear power plants as sources of electric power, for nuclear heating plants that supply heat to industry and public utilities, and for nuclear cogeneration plants as combined sources of electricity and heat. Of course, the more distant future, too, has been taken into account so that the criteria may satisfy also

the fast breeder reactors that gradually will replace the present installations. And if we add to this the dumps for solid or solidified wastes, the storage facilities for spent nuclear fuel, and the other necessary structures, we find that the selection of construction sites will not be easy.

Rules for Selection

The experience to date in our country and abroad, and especially the practice in the Soviet Union indicate that the following aspects are decisive in selecting nuclear energy capacities and their construction sites:

--The demand for sources of energy (electricity or heat) in the country's given region, starting out from the objectives of society's economic and social development in the period in question;

--The technical feasibility of the nuclear installation under acceptable economic conditions, with a maximum return at minimal investment and operating costs;

--The social consequences, and the resulting need to set appropriate priorities;

--Safety of operation, which involves the exclusion or reduction of the natural and man-made effects on the operation of the nuclear installation to an extent that rules out the loss of some important component's ability to function, a breakdown of normal operation, and the development of conditions for a nuclear accident;

--The impact of the nuclear energy installation on the population and living environment in its vicinity.

These aspects have led to the formulation of a set of rules for selecting the sites of nuclear energy installations. The Czechoslovak Atomic Energy Commission issued these rules in 1979 as the general criteria for ensuring nuclear safety when selecting the construction sites. In spite of its essential simplicity, this set of rules has been unique so far in world practice. But it has provided the prerequisite for a uniform approach. Already at the time when the central agencies were presenting their comments on the draft proposal, the rules were tested in practice in the course of selecting the site for the Mochovce nuclear power plant in Levice Okres. Construction of the last power plant that will be equipped with 440-MW VVER [water-cooled, water-moderated power reactor] reactors has already begun.

Temelin and Other Sites

The developed system of site selection has made it possible to prepare a prognostic study of the possibilities of locating nuclear energy installations in Czechoslovakia. The study includes nearly 30 localities in all krajs and is a valuable guide for the nuclear program's further development. The new criteria were fully applied in selecting the site of a nuclear power plant for South Bohemia. Twelve alternative sites were selected, more than half of them on the right bank of the Vltava. In the course of evaluating these sites, the choice

was narrowed to Malovice, Dubenec or Temelin, all of them on the left bank of the Vltava. Finally Temelin proved suitable for the first nuclear power plant with four 1000-MW VVER reactors. Preparations have begun there for the construction of the power plant that will be our largest power-generating center.

Thus today we are already able to explain and justify why the particular sites have been selected for the power plants that are in operation, under construction or being prepared for construction, or where additional power- and heat-generating capacities will be located. All of them are close to a power grid, and in localities that are optimal from the viewpoint of a heat-distribution system. In both instances the main consideration is the reduction of energy losses. The Jaslovske Bohunice, Dukovany, Mochovce and Temelin power plants are located along our southern power grid.

By the year 2010, moreover, nuclear cogeneration plants of the same capacity as in Temelin are being considered for East Bohemia and East Slovakia, where site selection has already begun, and also for Central Bohemia (Prague) and North Moravia. Opatovice and Holice in Pardubice Okres have been chosen as alternative sites in East Bohemia, after Nechanice and Chlumenec nad Cidlinou proved unsuitable. In North Moravia the sites of Majetin in the Olomouc area, and Starojicka Lhotka in Prerov Okres have definitely been abandoned. But because the supply of heat for Olomouc is urgent, other alternative sites are being considered. Work is similarly advanced in East Slovakia.

The motive in East Bohemia Kraj is the supply of heat for Hradec Kralove and Pardubice. The nuclear cogeneration plant in North Moravia is to supply heat not only for Ostrava, but also for Karvina, Frydek-Mistek and Havirov; and in the eastern part of the republic, for Kosice and Presov. In Central Bohemia Kraj a site is being sought for a plant that will be able to supply large quantities of heat for Prague, particularly its norther and northwestern parts. In each of these instances the nuclear cogeneration plant would be based on 1000-megawatt reactors of the VVER type. The development of nuclear heating plants is nearing completion in the Soviet Union. Such plants are being considered in the long run for Bratislava, Plzen, Usti nad Labem, Liberec, Gottwaldov, Ostrava or Olomouc, Zilina, Banska Bystrica and Humenne.

Weighing the Advantages and Drawbacks

From this review it is evident that both the overall energy strategy and local needs provide the impulse for location and site selection. Initially a large number of alternative sites is considered in the region or area. Gradually also the other criteria are evaluated and are compared with the economic parameters of building and operating the assumed development of nuclear energy. The outcome of selection are two sites, of which the one that is economically the more advantageous will be given preference.

The operation of a plant that generates nuclear energy requires a relatively large volume of cooling, feed- and drinking water. The plant's site must permit the supply and removal of this water, and perhaps also a certain reserve of cooling water directly at the plant. In the same way it is necessary to move the generated electricity or heat from the plant at the lowest possible losses. And finally, the location of the construction site must permit the construction

of transportation routes for supplying the site with large volumes of materials and for delivering the heavy, large, intricate and sensitive subassemblies and structures of the technological equipment. The construction site and future plant must also provide easy access for the construction workers and operating personnel.

Admittedly, these requirements can be met at any construction site, but the price of meeting them will differ. And not merely in terms of the financial costs. For all these requirements have a direct bearing also on the safety of the plant's operation. For example, the cooling of the reactors must be ensured under all circumstances, even when they are shut down for a longer period of time. Which means that an entirely independent source of cooling water must be available. In the same way, an alternate power supply must always be available should the nuclear plant suddenly cease to generate electricity. The situation is solved by means of another independent power-supply line of very high voltage, or with a standby diesel generator and a sufficient supply of diesel fuel.

Access to the nuclear plant must be ensured for its personnel under all circumstances, so that the plant's operation may be under constant and reliable control.

[No 8, 22 Feb 84 p 16]

> [Text] The entry of a nuclear power plant into an area resembles a small-scale migration of nations, accompanied by great changes of the environment. This step is preceded by a series of negotiations and conflicts of the most diverse interests. This is understandable because new, entirely different and locally unusual economic and social relations develop. No wonder, then, that local obstacles are often raised, and there are efforts to move the construction project elsewhere. These obstacles and efforts must be overcome repeatedly and with patience.

Artificial obstacles are removed by meaningful arguments and justifications. The obstacles that are real, not invented, and well substantiated must be taken into consideration, and an acceptable compromise must be sought. Because every construction site for a nuclear energy installation is approved by a government resolution, the federal government assumes the demanding role of arbiter of the conflicts of interest.

Based on the experience to date, the following considerations are the most important ones:

--Protection of the available farmland and forests;

--Exclusion of possible interference with the unique character of the designated and presumed state natural reservations, historical monuments, national parks, protected environmental areas, findspots, and possibly also the protective zones of such territorial units;

--Protection of areas that have nonreusable natural and mineral resources (deposits of mineral and other natural resources and the areas of their extraction, buildings and complexes that have higher territorial and technical requirements, and different plans for land use);

--Exclusion of construction sites where they would interfere with important railroad lines, expressways, waterways and telecommunications.

Naturally, the described cases of possible conflicts of interest apply at the time when the conflicts arise, and they reflect also the level of familiarity with the problems of nuclear energy.

Then Where Should We Build?

Safety considerations in selecting the sites of nuclear installations fill out the remaining knowledge gaps regarding the properties and characteristics of the territory and construction site. They are equally important factors in the decision-making process and often are intertwined with the other requirements. Not even the economic feasibility study may disregard the cost and benefits of measures to improve safety.

The probability of an earthquake of such intensity that it could damage the technological or control equipment, make it inoperable or even cause an accident is assigned the greatest weight. Therefore areas are excluded where the intensity of an earthquake could exceed the values specified in the regulations and standards. The basis is the Soviet standard that starts out from historical data and analyzes the disturbances and potential movements of the earth's crust. Simultaneously the height of the groundwater's level, and the composition of the foundation soil's surface and subsurface strata also are evaluated from the viewpoint of how they will affect the propagation or damping of earthquakes.

The danger stemming from landslides, from past, present or future mining operations, from the location of the construction site in a karst region, from the low load-bearing capacity of the soil and from a high water table is evaluated in the same or similar manner. A site is ruled out when there is danger that the nuclear installation might be flooded when nearby streams overflow or an upstream dam fails, even if the probability of such an accident is very small.

Increasing importance is attributed to the effects and consequences of industrial or other activity in the vicinity of the considered site. The possibility of damage to sensitive elements of the nuclear plant in an airplane accident is assessed very strictly. Industrial activity that produces toxic or choking emissions, or gaseous materials or products, rules out or considerably limits the selection of a site for a nuclear installation, and the construction sites are removed also from the routes of petroleum or gas pipelines. The probability of exceptional and extreme meteorological phenomena--such as destructive tornados, cloudbursts, ice storms, heavy snowfall, strong winds, and combinations of these phenomena--does not vary much over the territory of Czechoslovakia, with the exception of the mountainous regions. Nevertheless the possible consequences of such occurrences are taken into consideration when designing nuclear installations.

Thousandfold Safety Margin

Depending on their nature, also the location of the construction site increases or reduces the effects that the operation of nuclear energy installations has on the area, its use, the living environment, and on the people living in the area. Sites are chosen on the basis of the population and dwelling-unit densities of the area. Proof that the dose of emissions per individual, and the total of these doses for all the individuals within a specified radius from the source (the so-called collective dose) will not exceed the permissible values must be submitted already in the phase of site selection, on the basis of the design data on the composition of the emitted gaseous and liquid wastes. The results and experience to date indicate that there is a thousandfold safety margin in comparison with the maximum permissible values that the regulations require! In spite of this there must be room at the selected site for an exclusion zone without permanent residents. Sources of potable water and mineral springs must be protected from the combined effects of the gaseous and liquid wastes of nuclear installations, including also chemicals and petrochemical residues. Therefore significant and irreplaceable sources of drinking water and mineral springs in an area rule it out as a construction site. And finally, farming in the immediate and wider vicinity, and the mode of supplying the population with food and drinking water also are taken into consideration in the course of site selection.

Evaluation of the selected sites for nuclear energy installations is predominantly analytical activity. On the basis of worldwide experience, a series of statistical testing methods has been elaborated for the complete and comprehensive evaluation of areas intended for sites of nuclear energy capacities. In our country TERPLAN, the State Institute for Territorial Planning, is concerned with comparing the suitability of the selected sites. It has chosen a set of evaluation criteria, assigning them values on a ten-point scale. The method it developed in this manner has already been used to evaluate the site of the nuclear cogeneration plant in Central Bohemia.

In the two installments of this article we have demonstrated that it is not easy to select a site for a nuclear power plant. But we have not answered the basic question: Do we have sufficient sites for future nuclear energy capacities? This question may be answered in the affirmative, but at the same time we must bear in mind that we have to use prudently and sensitively the sites available for nuclear power plants. We have to think of the more distant future, because the future energy-generating central stations based on nuclear fusion will also require space. We do not know as yet what these requirements will be. Nor do we know what type of sites they will need. Before the nuclear-fusion plants, we will probably come to the era of fast breeder reactors. These will be able to utilize current nuclear fuels practically without any waste and also to produce more basic fissile material than what they consume. Will we find for them construction sites with sufficient cooling water to remove the heat that we are unable to convert into electricity according to the principle of physics?

Many of these and similar problems will be solved by the students we now see daily in the streets carrying their schoolbooks. Because they will be needing more energy than in our time, or will strive to make theirs a nicer and better world. But we are laying the foundation of their prospects already now.

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CSO 5100/3010

COMMENTATOR SPECULATES ON PAKISTAN NUCLEAR CAPABILITY

Bombay THE TIMES OF INDIA in English 29 Feb 84 p 8

[Article by K. Subrahmanyam: "Pakistan's Nuclear Capability; What Do Latest Statements Mean"]

[Text]

DR. A. Q. Khan, in his interview to the Pakistani Urdu daily *Nawa-i-Waqt*, has made it clear that Pakistan has reached uranium enrichment capability and if the government of Pakistan were to make the decision to make the bomb the scientists in that country were in a position to do so. He has claimed that Pakistan has achieved the technological capability in regard to uranium enrichment reached so far only by the U.S., the U.S.S.R., France, China, the U.K. and the consortium of three European states (West Germany, the U.K. and Netherlands). He has also pointed out that in respect of the uranium enrichment technology Pakistan had overtaken India and is justifiably proud that Pakistan was able to achieve in about seven years what took the European consortium 20 years to achieve. General Zia-ul-Haq, on his return from Moscow, said to the press on February 15 that Pakistan had acquired a "very modest research and development capability" in the enrichment of uranium.

When Dr. Khan classifies Pakistan along with five nuclear weapon powers and claims of having reached the enrichment capability attained by the European consortium after 20 years, it is obvious that he cannot be referring to a modest R and D capability. Further, according to official documents of the Dutch government, Pakistan had imported 6000 centrifuge tubes by 1979. And there is the reference to Pakistan's capability to produce a nuclear weapon if a decision were taken. From all this it is a justifiable inference that Dr. Khan and General Zia-ul-Haq were trying to communicate to the world that Pakistan has started production of enriched uranium of weapon grade in commercial quantities.

There have been a number of reports over the last three or four years of Pakistan acquiring clandestinely equipment needed to produce the trigger device and it will be a fair assumption that such attempts had been pursued by Pakistan along with its efforts to master the technology of enriching uranium to weapon grade. Pakistan has not so far conducted a test on its soil. Reports about a seismic event in Ras Koh mountain region in the middle of last year related to a natural earthquake and the epicentre 30 km below the surface.

U. S. Concern

What made Dr. Khan come out with such a statement in public? To argue that he was provoked by the excerpts from the book "Islamic Bomb" published in a Pakistani journal appears to be simplistic. Dr. Khan has a long record of keeping silent and not being easily provoked. Nor would such extracts appear in a journal in Pakistan casually. We have to seek alternative explanations.

In November 1983 Argentina announced that it had achieved uranium enrichment capability and the report was confirmed by Dr. Hans Blix, director-general of the international atomic energy agency (IAEA) after a visit to the facility. In spite of the announcement the U.S. is going ahead with the supply of heavy water to one of the Argentine reactors though there have been protests within the United States. One wonders whether Pakistan is also trying to test out the U.S. sensitivity to the announcement that it has reached the weapon grade uranium enrichment capability.

The U.S. ambassador in Islamabad, Mr. Ronald Spiers, in his speech to the institute of foreign relations, Karachi, on April 20, 1982, had warned that several actions short of a nuclear test, such as reprocessing of spent fuel could seriously disturb the U.S.-Pakistani arms relationship. On September 10, 1982, in an interview to *Nawa-i-Waqt*, ambassador Spiers again referred to the U.S. stand on non-proliferation which did not allow the U.S. government any alternative but to stop economic aid to any country that continued to implement a programme of reprocessing and did not conform to international safeguards. The principal deputy assistant secretary of state, Mr. Harry Marshall, in his article based on his address to the international nuclear law association (September 27, 1983) specifically referred to the U.S. concern about Pakistan's continued efforts to complete the construction of an unsafeguarded enrichment plant and the consequent U.S. decision to discourage various suppliers from bidding for the proposed

Chashma nuclear power station. The U.S. has up to now succeeded in preventing bids for the Chashma project though the Pakistanis have extended the period for bidding five times.

In the U.S. foreign military sales programme for the coming fiscal year, Pakistan is one of the countries listed to benefit from the liberalisation of terms of financing of weapons purchases. Therefore it will be logical to ask why Pakistan should make a public announcement of its achieving enrichment capability and thereby put into jeopardy its arms relationship with the U.S.?. On the face of it such a course of action would appear to be fraught with risks, but there appears to be a sophisticated strategy underlying it.

Israel As Model

Though the Pakistanis attack Israel and the Zionists day in and day out, in reality Israel acts as a model for Pakistan since both states are born out of two-nation theories and the Pakistanis consider themselves as a marti and chosen people just as Israelis do. Israel has successfully adopted the strategy of ambivalence in regard to its nuclear policy. As far back as January 1973 the President of Israel made public that Israel was in a position to make nuclear weapons. Israel's intention to do so was subsequently denied but it was asserted that Israel would not permit any other Arab country to be the first to introduce nuclear weapons in West Asia. According to Israeli literature, that country has an arsenal of more than two hundred nuclear weapons. But the Israelis have not carried out a test since the days when tests started getting monitored internationally. One unconfirmed report has it that they did carry out a test in the early sixties before effective international monitoring began. Because of this strategy of ambivalence, the U.S. excuses itself from invoking its nuclear non-proliferation law against Israel. The Pakistanis are today attempting to place themselves in the same category as Israel and are trying to test whether the U.S. would invoke the non-proliferation law against it.

The waiver of the Symington Amendment in favour of Pakistan by the Reagan administration in 1981 was a clear signal to Pakistan that the U.S. need to supply arms to Afghan insurgents through Pakistani territory outweighed its non-proliferation objective. Even as the U.S. administration officials were assuring Congress that arms supplies to Pakistan resulted in an increased sense of security and kept Pakistan from going nuclear, efforts were being vigorously pursued in Pakistan to reach the weapon grade uranium enrichment capability.

Now by announcing that they have reached that capacity, the Pakistanis are quietly challenging the U.S. to implement the threats implied in the pronouncements of people like Mr. Spiers and Mr. Marshall. It is extremely unlikely the U.S., with the Israeli albatross around its neck, will act. So long as Pakistan does not carry out a nuclear test on its soil it is likely to get away with its nuclear programme.

Pakistan, at the present moment, appears to have considerable leverage in the U.S. in this respect. Last year the Pakistanis created some alarm in the U.S. through their indirect negotiations with Kabul. With the happenings in Lebanon, the strategic cooperation agreement between the U.S. and Israel and the American inability to compel Iran to agree to the termination of the Gulf war the U.S. credibility in the Arab world is not high. Nor is Arab morale. Hence, the value of Pakistan to the U.S. is relatively high at present than during earlier periods.

National Ambition

Pakistan has been steadily preparing both its own population and the outside world to accept its need to go nuclear. The former foreign minister, Mr. Agha Shahi, spoke about the possibility of the Soviet Union deploying nuclear weapons in Afghanistan and South-West Asia becoming a nuclear battlefield. The U.S. strategists and media have been giving extensive publicity to the Soviet SS-20s in Asia posing a threat to all Asian countries including those in South Asia. The Pakistani ambition to go nuclear is also a matter of national consensus in that country.

Apart from these factors there is the well-known explanation for certain countries going nuclear put forward by the American strategic community. Prof. Stephen Cohen of the University of Illinois, for instance, points out that "Pakistan belongs to that class of states whose very survival is uncertain, whose legitimacy is doubted and whose security-related resources are inadequate. Yet these states will not

go away nor can they be ignored. Pakistan (like Taiwan, South Korea, Israel and South Africa) has the capacity to fight, to go nuclear, to influence the global strategic balance (if only by collapsing) and, lastly, is in a strategic geographical location, surrounded by the three largest states in the world and adjacent to the mouth of the Persian Gulf....."

It is useful to remind oneself that the first bomb made out of enriched uranium dropped on Hiroshima had not been tested earlier. The one tested at Almagarado on July 16, 1945, was the plutonium bomb, the second of that series being dropped on Nagasaki. The uranium bomb's triggering mechanism was by the gun barrel technique which is technologically less complicated than the implosion trigger for the plutonium bomb.

Hence, it is not realistic to hold that a bomb test must precede the building up of a nuclear arsenal--especially in the case of weapons made out of enriched uranium. If there is some friendly help to check the design so much the better and a bomb test may be avoided especially if the objective is to pursue a strategy of ambivalence to augment one's bargaining strength. Not only is Pakistan in a position to build up a modest but, for its own purposes, effective enough nuclear arsenal, it can now put pressure on the U.S. that unless that country continues to supply armaments it will go overtly nuclear. Pakistanis are demonstrating that what Israel can do vis-a-vis the U.S. they can also do even if on a much smaller scale.

CSO: 5100/7061

AEC CHAIRMAN DESCRIBES NUCLEAR ENERGY PROGRAM

Madras THE HINDU SURVEY OF INDIAN INDUSTRY 1983 in English pp 81-85

[Article by R. Ramanna, chairman, Atomic Energy Commission]

[Text] INDIA has foreseen the potential of atomic energy for economic development nearly four decades ago at a time when prospects for its ues for destruction were imminent. A decade later, the objectives of the country's atomic energy programme were defined as the generation of electricity and development of diverse nuclear applications in industry, medicine, agriculture and research. With vast reserves of thorium and significant deposits of uranium, an appropriate strategy was chalked out to utilise these resources most effectively.

The strategy envisaged setting up uranium-fuelled thermal reactions in the first instance to produce electricity and plutonium, followed by plutonium-fuelled fast breeder reactors to produce electricity and more plutonium using the discarded uranium from the first stage reactors as well as uranium-233 using a thorium blanket surrounding the fast reactors, and finally uranium-233-fuelled breeder reactors to produce electricity and more uranium-233 from thorium. Further studies established that nuclear energy could economically supplement the conventional energy resources such as coal and hydro-electricity for production of power at locations away from these resources. Thus, Tarapur came to be chosen as the site for the first nuclear power station.

Choice of reactor system

Concurrently studies were initiated to select the type of reactors which would meet our needs most. The choice was narrowed down to three types — the well developed natural uranium-fuelled graphite reactor and the enriched uranium-fuelled light water reactor, and the still developing natural uranium-fuelled heavy water reactor. Of the former two, the first looked more promising from the point of view of ultimate self-reliance.

However, after a global tender enquiry, it had to be ruled out on account of its very high capital costs. From purely economic considerations, the enriched uranium light water reactor was the only choice available.

Even at that time heavy water reactors looked much more promising from the theoretical point of view, as they could use uranium most efficiently as can be seen from the following Table:-

Efficiency of light water and heavy water reactors

	Light water reactor	Heavy water reactor
Natural uranium needed initially (t/MW)	0.80	0.21
Natural uranium needed annually (t/MW-yr)	0.21	0.19
Plutonium producing capacity (kg/t of natural U)	1.15	2.62
Plutonium produced annually (kg/MW-yr)	0.25	0.49

The lower fuelling cost for heavy water reactors was of particular relevance to India, as our uranium deposits are of much lower grade and consequently the cost of producing uranium is relatively higher than in many other countries. It was estimated that about 10,000 MW of nuclear power could be supported by our known uranium reserves.

Nonetheless, the decision to be taken two decades ago on the tenders received for Tarapur was obvious. The gas cooled reactor was extremely expensive, the heavy water reactor was not fully developed and the enriched uranium reactor was most economical. To bring nuclear power to the country early and to give an opportunity to Indian technical personnel to acquire experience in building and operating a nuclear station in an Indian electrical grid system, it was decided to purchase for Tarapur the well developed enriched uranium light water reactor system from the U.S.

Tarapur Experience

The light water reactors at Tarapur were commissioned in 1969. During the initial years of operation, several teething problems were experienced and several modifications requiring significant developmental work including mock-up trials had to be incorporated. As a result, the frequency and duration of shutdowns was progressively reduced and an availability factor as high as 85 to 90 per cent and a cumulative capacity factor of about 50 per cent have been attained. However, due to ageing of the reactors, many replacements have to be taken up and the shutdown duration is showing a tendency to increase.

The frequency conditions in the western grid have become unfavourable in recent years as the grid system has resorted to sustained low frequency operation due to shortage conditions. The station has largely operated satisfactorily, supplying power to the Maharashtra and Gujarat grids. The performance of Tarapur has been generally satisfactory and compares favourably with that of other boiling water reactors in the world.

It is indeed unfortunate that from time to time, the Press misreports some of the problems at Tarapur, perhaps with a 'sensational scoop' in view. For example, there was a recent report implying a serious problem of radioactivity leakage at the station. What had in fact been happening for some time was that salt water was getting into the secondary cooling system through leakages in the condenser and some plugging measures had been going on as a temporary solution. The fact that the station had created a record for having operated continuously for 156 days was never mentioned. On account of this long continuous operation the reactor was shut down to attend to various planned maintenance jobs, as well as rectifying the leakage in the condenser.

There are no serious or major deficiencies in any of the equipment at Tarapur. In fact, a U.S. expert, who visited thk station in mid-1983, had reported to a Congressional Committee that Tarapur was running satisfactorily and producing 75 per cent of its rated power. The operators are good and follow U.S. radiation control practices. The radiation levels are certainly not worse than those found in some American plants.

Rajasthan unit's contribution

The heavy water reactors were chosen for the Rajasthan station. While major equipment for the first unit was imported from Canada, the indigenisation process for the second unit was significant. Thus, the station opened opportunities for many in-

dustries to enter the nuclear power field and develop sophisticated technologies for the first time.

During the initial stages of operation, the first unit experienced considerable disturbances and outages due to frequency variations, high/low voltage conditions and fast changes in voltage and frequency. The unit's performance has been much below the target. The availability factor up to the end of 1981 was 43 per cent and the capacity factor 31 per cent. Since 1982 the unit faced difficult technical problems.

The end shield, which is a heavy fabricated component cooled by ordinary water, developed a leak in a very inaccessible part. This was first noticed in September 1981. A temporary fixing of the leak was attempted towards the end of 1981 and the unit was restarted in early 1982. However, after operating only for a few weeks, the leak recurred and the unit had to be shut down again in March 1982. The location of the leak has now more or less been established and work is on hand to pinpoint it precisely prior to carrying out permanent repairs. The inaccessibility of the location and the radiation fields have necessitated use of many remotely operated tools specially developed for this work. Such a problem has not arisen in any similar reactor, and hence, considerable original problem-identifying-cum-solving has to be carried out on our own.

The second unit achieved an availability of 80 per cent in 1981, the first year of its operation. In 1982, there was a long outage due to turbine blade failure. Some stages of high pressure rotor of Unit-1 were strengthened and used in Unit-2 and the unit operated in a steady and dependable manner in the later part of 1982. However, in January 1983, the unit had to be shut down again due to high vibration in the turbine bearing due to failure of two blades in the same replaced high pressure rotor. The unit came back on line in February 1983 and is now operating at a power level of about 180 MW. The cumulative capacity factor for this unit is about 37 per cent and the availability factor 75 per cent.

When assessing the performance of the Rajasthan reactors, it has to be remembered that these two are in a way demonstration reactors. When the station was designed, the only other similar reactor at Douglas Point in Canada had not yet gone into operation. The only experience available was on a 20 MW demonstration reactor in Canada. After 1974, there has been no contact with the original designers or equipment suppliers. All the problems encountered in the operations and maintenance have had to be solved by our own efforts.

One factor for the low availability of the reactors has been the trouble with the turbine generators. There have been four instances of turbine blade failures. Normally, being a conventional piece of equipment, the turbine is expected to operate trouble free. Some of the difficulties stem from the fact that the financing agreement had specified buying this equipment only from Canada. Thus, a Canadian manufacturer without any previous experience on a comparable turbine took up the manufacture for the time.

Kalpakkam, a new landmark

The commissioning of the first unit of the Madras station at Kalpakkam marks the coming of age of the Indian atomic energy programme as the responsibility for engineering, constructing, commissioning and operating the station rests with Indian engineers and scientists. India has become the seventh country that has developed the capability to

execute nuclear power plants totally on its own. In no other sector of industry has such a bold challenge of establishing self-reliance from the third project onwards been realised.

While the Madras station is largely based on reactors similar to those in Rajasthan, several significant changes have been incorporated to improve performance and safety. The near-complete indigenisation of equipment and materials was a major objective and this task has certainly not been an easy one.

Design Changes

Among the important design changes that had to be carried out was the construction of a tunnel under the seabed, the first of its kind in the country, to draw silt-free sea water for cooling the plant. An indoor switchyard, also for the first time in the country, was built to house the high voltage electrical equipment. Experience at Tarapur had indicated a risk of frequent interruptions arising from the salty environment. To meet the stringent radiation safety requirements, a double containment reactor building was constructed with the inside consisting of prestressed concrete to withstand internal pressure and the outside of rubble masonry for shielding.

Soon after the synchronisation of the first unit at its inauguration in July 1983, it had to be shut down for several statutory tests to be carried out before its power level could be raised. The unit was operated up to a power level of 200 MW. The unit has been performing much better than the near-imported first unit of Rajasthan and has been taken near its rated capacity in a short period.

The construction of the second unit at Kalpakkam is progressing satisfactorily. The equipment is in its final stages of erection, and if all goes well, the unit should become critical by the end of 1984.

Narora as test ground for bigger units

The design of the two heavy water reactors at Narora in Uttar Pradesh has posed several engineering problems. Narora being situated in a seismic zone, an extensive earthquake-proof design had to be carried out, not only for the buildings but for all the nuclear equipment. In addition, it incorporates several new design features with the idea that some of these concepts could be used for the 500 MW reactors of the future. Equipment erection work is progressing and the two units are expected to be commissioned by late 1987 and 1988 respectively.

Plan for 10,000 MW

The present total installed nuclear power capacity in India is about 1,100 MWe and a further 1,200 MW is under construction. Our nuclear programme is quite modest when compared to many of the industrialised countries. For example, at the end of 1982, the installed nuclear power capacity in the U.S. was over 60,000 MW, in France over 20,000 MW, in Japan over 16,000 MW and in the USSR over 17,000 MW. During 1982, the number of operating power reactors exceeded 300 and continues to increase.

Nuclear power reactors now account for about 10 per cent of world electricity production and this figure is likely to nearly double by 1990. By the end of the century, further increases are forecast. For example, it is envisaged that France will have nearly 70 per cent of its electricity from nuclear stations by 2000 A.D.

At this juncture, India is at the crossroads as far as nuclear power development is concerned. A stage has now been reached when it is possible to plan for a quantum jump in the nuclear capacity in view of the availability of adequate uranium and expertise developed in setting up plants for nuclear fuel, heavy water, spent fuel reprocessing and waste management, and most important of all, capabilities of local industry. One of the main requirements for achieving a substantial increase in capacity is a long-term commitment by the Government, so that industry in turn can mobilise the resources to ensure timely deliveries of equipment and also effect economies of scale.

The time appears to be right for a bold decision to expand the nuclear power programme. We must not be left behind in the nuclear power revolution.

With the many achievements of engineering and fabrication of critical nuclear components to our credit, together with the extensive industrial and research infrastructure that has been developed, a target of 10,000 MW of nuclear power by the turn of the century has been set. In fact, in 1979 a working group of energy policy of the Union Ministry of Energy was in favour of even a higher target! But how realistic is this target to achieve in 17 Years? This kind of growth rate will naturally depend on several factors like, economics of nuclear power, capacity of our industry, availability of adequate heavy water, trained manpower and financial resources.

For achieving the 10,000 MWe target, it is proposed to install another 12 units of 235 MW each in addition to those already under construction. Concurrently, design of a 500 MW unit is planned to be completed by the late Eighties and hopefully ten such standardised units may be possible by the end of the century. In case we fall short of this target, perhaps import of a few reactors can be considered, if and only if, the terms and conditions for such import are commercially attractive and politically favourable.

Economics of nuclear power

As early as 1955, even with the then available sparse data, Dr. Homi Bhabha had indicated that nuclear power would be cheaper at distances away from coalfields. Later experience from Tarapur has borne this out. But the capital cost of such stations has increased from Rs. 1,600 per kW for Tarapur to Rs. 3,000 for Rajasthan and Rs. 5,000 for Kalpakkam and about the same for Kakrapar. The current cost of similar stations is estimated at Rs. 10,500 per kW. In comparison, a thermal power station now costs Rs. 8,500 per kW. Thus the capital cost of nuclear stations is about 25 per cent higher than for thermal stations.

At the outset it must be stated that comparison of nuclear and thermal station costs is always difficult, because the methods of costing are different, certain items of expenditure are included in one but not in the other, capacity factors are different and the like. For comparison on an equitable basis, several assumptions have to be made. The following Table shows the cost of power from nuclear and thermal power stations of similar size based on 1983 prices.

It will be seen that the cost of power from a nuclear station is quite comparable with even a pithead thermal station. If the past trends in increase of pithead cost of coal, as well as its transportation by rail are taken into account, then nuclear stations will become even more competitive because coal constitutes nearly 40 per cent of the cost of electricity from thermal stations. Thus, the concept of break-even distance may not be of much significance in the future, and a good generation mix can improve the grid performance.

Comparative costs of power generation

	Nuclear	Thermal At pit head (paise/Kwh)	Thermal At 800 Km
Return on investment	26.6	25.2	25.2
Operation & Maintenance	2.9	5.2	5.2
Depreciation	7.9	7.5	7.5
Fuel consumption	5.1	15.0	24.0
Heavy water	6.1	—	—
Decommissioning	1.1	—	—
Cost of electricity	49.7	52.9	61.9

Strong industrial support

The pace of the nuclear power programme will naturally depend on its size and the state of industrial infrastructure. The development of indigenous capability has been achieved, perhaps at the expense of cost overruns and delays. There was just no other alternative as supplier countries have constantly been tightening their export policies for countries which have not signed the NPT, or are not willing to accept fullscope safeguards; conditions totally unacceptable to us, even if it meant accepting delays and higher costs for indigenisation.

A major problem for industry, both in the private and public sectors, has been the inability to maintain promised delivery schedules. The significant causes have been the developmental nature of the jobs involving a learning process, which often continued during the entire manufacturing period, tightening of the quality

control requirements and shortage of vital inputs such as power and industrial consumables.

An accelerated programme of constructing nuclear plants in the coming years will call for simultaneous production of nuclear components in a number of workshops. This will involve close participation by industry in mobilising additional resources in terms of manufacturing facilities and manpower, and in carrying out developmental tasks necessary for finalising designs and fabrication procedures especially for the larger unit size. Such steps have been initiated in the case of critical and long delivery items like end-shields, calandrias, steam generators and primary coolant pumps.

Heavy water availability

One of the crucial inputs for meeting the nuclear power target is of course heavy water. It is true that our heavy water programme has fallen behind. Unfortunately, to overcome our immediate and near-term requirements, imports are not possible, without accepting conditions such as fullscope safeguards, even though, strictly speaking, heavy water is not a nuclear material as such.

The oldest heavy water plant in the country is at Nangal which is based on hydrogen distillation process, and produces about 14 tonnes a year. For Baroda and Tuticorin we chose the ammonia-hydrogen exchange process, technology for which was obtained from France and Switzerland. We have also chosen the same process for the Thal plant as we believe there is nothing wrong physically with this process.

The Kota plant is based on the hydrogen sulphide-water process developed on our own at Trombay. The plant was mechanically completed in April 1981 and is expected to be fully commissioned by the middle of 1984. We have chosen this process for the 185-tonne Manuguru plant also.

It should however be remembered that with respect to technology for our entire heavy water programme, we are totally on our own, and all the problems encountered in this unique area have to be solved by our own experience and investigations. All this takes time. In fact, heavy water plants abroad have had similar teething troubles like the ones we are facing. Eventually, they have been overcome by analysis of the difficulties and through experience. We are just getting out of this process and are confident that the plants at Baroda, Tuticorin, Thal, Kota and Manuguru will work satisfactorily. With the successful commercial operations of these plants, we will be producing adequate heavy water to support a nuclear power programme upto 5,000 MW. Two or three more large heavy water plants will be needed to meet the requirements upto 10,000 MW.

Investment pattern

The total capital investment needed for such an ambitious programme is large but what is not fully appreciated is that this investment would be only a fraction of the total needed anyway for attaining the total power target of nearly 100,000 MW of capacity planned for the end of the century. It may also not be fully appreciated that power stations, whether nuclear or thermal, once installed, start earning money from the sale of electricity.

A tentative estimate of the financial resources needed for a 10,000 MW programme indicates outlays of the order of Rs. 1,000 to 1,500 crores a year during the Nineties. The annual revenue from sale of electricity, as the stations are gradually commissioned, is estimated to increase from about Rs. 1,000 crores in the mid-Nineties to over Rs. 3,000 crores by the beginning of the next century.

With the establishment of 10,000 MW of nuclear capacity based on natural uranium reactors, adequate plutonium will be produced annually making it possible to add 1,000 MW of fast breeder reactors every year. This plutonium, together with the unwanted uranium-238 left over from the first stage reactors, will enable the putting up of 350,000 MW of fast breeder reactors in the next century. Thus, the installed nuclear capacity that can be supported by our somewhat limited uranium reserves can be increased almost 35 times. This is the target set for our fast reactor programme.

As a step towards the second phase of the nuclear power programme, a separate Reactor Research Centre has been established at Kalpakkam for undertaking all the necessary development work connected with the fast breeder programme. A 15 MW fast breeder test reactor is nearing completion at this centre. The civil construction has been completed and all the major reactor equipment has been installed. The piping and control and instrumentation work is in progress. The reactor is expected to attain criticality by the end of 1984.

For carrying out research and development in all the associated technologies, several laboratories for physics, metallurgy, reactor safety, sodium technology, reprocessing, radiochemistry, radiometallurgy and other related fields have already been set up. Several R & D activities have been completed and others are under way.

Trombay centre for plutonium fuel elements

A facility for manufacturing plutonium fuel elements for the fast breeder test reactor has been set up at Trombay and trial runs have been carried out. This entire production line is located in glove boxes as the handling of plutonium has to be done remotely. Thorium oxide fuel elements have already been fabricated in another facility at Trombay. It is proposed to use the thorium fuel in the blanket region of the fast-breeder test reactor. An optimum strategy for thorium utilisation will be developed after adequate experimentation.

The experience gained at the Kalpakkam centre has provided the confidence to undertake the design and construction of large prototype fast breeder power reactors. The feasibility report for a 500 MW prototype fast breeder reactor has recently been prepared. This report also outlines the plans for taking up all the supporting developmental activities like fuel fabrication, spent fuel reprocessing and fabrication of nuclear components.

Fusion research at new centre

Nuclear fusion offers the promise of an inexhaustible source of energy. The required fuel occurs in nature in great abundance. No fission products are produced and environmentally it appears to have potential advantages. Fusion is still in its early stages of research and two promising approaches are being investigated — magnetically confined fusion and inertial confined fusion.

The inertial confinement approach appears to be more promising because of the rapid advances made using electron beams and lasers for attaining the required temperatures. The last few years have witnessed progress in the technology of focussing relativistic electron beams on the surface of targets, compression of fusion fuel and its heating to very high temperatures. Research to date has demonstrated laser driven implosion of deuterium-tritium filled pellets, with observed thermonuclear neutron production. Development of high power lasers and associated optical engineering is now needed to bring this system to fruition. Since a large part of the laser fusion programme abroad is classified, we will have to develop our own expertise in this field.

Another line of research is connected with the use of high energy particle accelerators. It is worth noting that accelerators, which at one time were considered instruments for basic research, are already being used as tools in a number of areas of applied science, as for treatment in hospitals, and are fast becoming giant machines which can be used for future nuclear power stations. A high energy accelerator can be used to get neutron fluxes two orders of magnitude higher than with the present flux nuclear reactor. This intense neutron source can be used for directly converting fertile material like thorium into uranium-233. Such accelerator-based nuclear power systems are in the conceptual design stages.

In order to undertake research and development in these forward thrust areas of lasers, fusion and accelerators, it has been decided to set up a third research centre — the Centre for Advanced Technology, near Indore in Madhya Pradesh.

From all considerations, the Indian programme can be considered as a well thought out one, which is well within our capacity. In fact, it has inspired many developed and developing countries. Fortunately we have sufficient manpower which can be trained to handle the various tasks involved.

CSO: 5100/7066

DAE OFFICIAL WRITES ON HEAVY WATER PRODUCTION

Madras THE HINDU SURVEY OF INDIAN INDUSTRY 1983 in English pp 143, 147

[Article by N. Srinivasan, chief executive, Heavy Water Projects, Department of Atomic Energy]

[Text]

WITH limited resources of uranium, the only known system that will ensure a sustained growth of nuclear power on a long-term basis is the pressurised heavy water reactor. If this system has to be established without any infringement of our sovereignty or independence of foreign policy, indigenous availability of heavy water is an absolute requirement.

This was recognised even at the beginning of nuclear power planning and a programme was initiated for production of heavy water.

The Nangal heavy water plant, commissioned in 1962, and the R&D in heavy water production initiated in the early Sixties, marked the beginning of this programme.

Earlier processes

At the time the programme was initiated, electrolysis, water distillation and hydrogen sulphide-water exchange were the processes prevalent. The last one was the most successful process established for large-scale production of heavy water. The Savannah river plant in the U.S. and Glacebay plant in Canada were the early ones based on this process. These were of small capacity. The former was reported to have operated satisfactorily meeting the requirements of the reactors used for producing plutonium for military purposes. Except for the production reactors the U.S. had no interest in the heavy water programme.

Canada took up the pressurised heavy water reactor route for its civilian programme and concentrated on development of technology for getting heavy water on a large scale. Despite the availability of the Savannah river plant's operational experience, various problems were encountered and the Glacebay plant had to be revamped. It was recommissioned 15 years later. The other plants built in Canada for much larger quantities have also had initial problems and reached production three or four years after commissioning.

Reports about the bitter experience of Canada led India to search for alternative processes. The monothermal ammonia-hydrogen exchange process demonstrated in a small plant in France was found attractive in conjunction with the large-sized fertilizer plants that were coming up in the late Sixties. The acceptance of this technology was not preceded by any local developmental efforts and the heavy water plants at Baroda and Tuticorin were essentially turnkey projects.

Baroda, Tuticorin units' problems

The Baroda plant designed to produce 67 tonnes of nuclear grade heavy water annually was commissioned in July 1977 but following an accident in December 1977, it became inoperative and was re-commissioned in February 1980. The 71-tonne-a-year Tuticorin unit was commissioned in 1978. Neither of these plants has operated to the expected capacities so far on account of a variety of problems.

Due to lack of experience with large size fertilizer plants and with the heavy water technology, assumptions were made on the basis of optimistic capacity of 8,000 hours of concurrent operation of both plants and 125

ppm. of deuterium in the feed gas. The first assumption was not realisable particularly in a single stream plant like the one at Tuticorin located in an area of acute power shortage.

The deuterium content in the gas was affected adversely not only by the process adopted in the ammonia plant but even by the choice of the booster compressors for synthesis gas. In the ultimate analysis, the deuterium content in the gas ranged between 105 and 115 ppm.

The Baroda plant had many problems on account of the high pressure for which the specialised equipment were being designed for the first time. The equipment problems in the heavy water plants have been progressively overcome and it is expected that both plants will operate to the maximum possible capacity in the near future.

The Talcher plant built on the biothermal version of ammonia-hydrogen exchange process employs simpler equipment than those used for the monothermal process at Baroda and Tuticorin. The linkage of the plant to a coal-based fertilizer plant, which itself is a new technology-oriented unit, has been criticised. In the search for high technologies at that time this was a valid choice. Coal-based fertilizer production is of long-term importance in the context of our own limited oil resources. The fact that the Talcher fertilizer unit has not so far operated satisfactorily is due to various decisions taken during the construction stage in the choice of equipment and in the assumptions made on the quality of coal. The assumptions were not realistic. The power situation in the area has also been unsatisfactory.

The equipment used in a heavy water plant are similar to those used elsewhere in the chemical industry. However, their particular application for the ammonia-hydrogen system with the gas cycling between two different temperatures is unique. The lack of plant scale experience with this technology has resulted in a large number of process problems being encountered in the commissioning.

Though the validity of these processes cannot be judged in the short term, there is considerable concern regarding the investments already made in this plant and reluctance to commit more funds without an assurance of improved performance.

Indigenous process at Kota

The plant at Kota was designed over a period of years and was built entirely by indigenous engineering though some equipment and materials had to be imported. Many initial problems had to be overcome and the trials have been quite satisfactory.

The plant has an inventory of hydrogen sulphide of 100 tonnes. The permissible contamination in the air is 10 ppm of hydrogen sulphide. With these two numbers, the extent of precautions in design, engineering, construction and operation that have to be taken to ensure safety of environment and personnel from the extremely noxious hydrogen sulphide can easily be imagined.

Concurrently with the development of these technologies the need for technology for upgrading the heavy water that leaks from nuclear power plants was also recognised. The escapes from nuclear power plants are considerable at times and mostly unavoidable. To maintain the economies of the reactor systems, the escaping heavy water must be recovered and ploughed back to the reactor after being upgraded.

Vacuum distillation and electrolysis have been found attractive for such upgrading and these processes have been developed in suitable combinations to ensure an optimised system from the point of view of cost, flexibility, losses and environmental pollution.

A plant based on electrolysis has already been set up at the Madras Atomic Power Station in Kalpakkam and is working better than design expectations. This plant is being supplemented with a plant based on distillation. An indigenously-designed upgrading plant based on vacuum distillation is already operating at the Rajasthan plant.

Thal project

The Thal unit with an effective capacity of 110 tonnes a year is associated with the fertilizer plant of Rashtriya Chemicals and Fertilizers and is being built by RCF on behalf of the Department of Atomic Energy. The technology here is based on ammonia-hydrogen exchange process.

India is the only country having extensive plant scale experience of this process today. The two-stream unit linked with a two-stream fertilizer plant, ensures gas availability. Design aspects have been examined to ensure maximum possible deuterium content in the gas as well as purity requirement.

The 185-tonnes-a-year plant at Manuguru in Andhra Pradesh based on hydrogen sulphide-water exchange process has also been progres-

sing satisfactorily and will be commissioned before the end of 1987.

Sites are also being examined to locate new plants of larger capacity based on H_2S — H_2O exchange process. Though this highly energy-intensive process costs more than the ammonia-hydrogen exchange process, it has the advantage of independence of external constraints, if it can have its own sources of steam and power.

CSO: 5100/7066

FUTURE OF RAJASTHAN N-POWER UNIT UNCERTAIN

Calcutta THE STATESMAN in English 6 Mar 84 p 12

[Text]

KOTA, March 5.—The continued closure of Unit No. 1 of the Rajasthan Atomic Power Project has put a question mark over its future, reports UNI.

The chief engineer of the project, Mr G. B. Nadkarni, told reporters that Unit No. 1 of the project situated at Rawatbhata in Chittorgarh district, had been closed because of leakage of heavy water. But he denied reports that Canadian experts had visited the plant and advised that it be closed permanently.

The plant was established with Canadian assistance but there was no agreement between the two countries for repairs, he said.

A major question to be settled is whether the closure of Unit No. 1, capable of producing 220 MW of power, will worsen the power crisis in the State.

Engineers and technicians are doubtful of the unit becoming operative, though Mr Nadkarni maintains that the leak, which is in one of the 308 horizontal and vertical tubes in the "end shield" of the "calendria" could be located. If it was not located, the calendria could be replaced.

The performance of Unit No. 1 had never been satisfactory during its nine years of operation till March 1982 when it was last closed due to heavy water leakage.

Those who are in the know of things at the RAPP are of the view that equipment for the project were imported from Canada even before that country had built one for its own use. The chief project engineer, Mr M. S. R. Sharma, claiming that the RAPP was an experimental project, said it would not be surprising if the defects remained "throughout its lifetime".

The peak production of the unit, 220 MW has never been achieved.

The maximum period for which the Unit No. 1 has operated is three months in 1979. After this, it used to trip up frequently and had often to be closed for several days each time.

According to reports, Unit No. 1 has had 251 breakdowns during its nine years of operation, while Unit No. 2 which was commissioned in 1980 has had 34 breakdowns in its second year of operation.

The power generation at the RAPP has never reached its maximum in its entire history. Only once, has it produced more than 160 MW of power. The generation has usually fluctuated between 25 and 42%.

Rajasthan State Electricity Board officials say even if the two units of RAPP together produce 230 of the 440 MW of power which it is capable of Rajasthan could tide over its power shortage.

CSO: 5100/7062

BRIEFS

BHABHA ATOMIC CENTER DIRECTOR--BOMBAY, March 7: Dr. P. K. Iyengat has been appointed director of the Bhabha Atomic Research Center here. This post was being held additionally by Dr. Raja Ramanna, chairman of the Atomic Energy Commission. Dr. Iyengar, the fourth incumbent to the post of director, BARC, was director of physics and chemical groups in the centre. The late Dr. Homi J. Bhabha was its first director. One of the foremost nuclear scientists in the country, Dr. Iyengar obtained his M.Sc. from the University of Travancore and his Ph.D. from the University of Bombay, as Dr. Ramanna's first student. He began his research in nuclear physics in 1952 at the Tata Institute of Fundamental Research. He gave the country an early start in neutron beam research by building neutron spectrometers in 1958 around "Apsara", in BARC, which was the first nuclear research reactor of Asia. Many innovations made by Dr. Iyengar in neutron scattering techniques are used throughout the world today. He trained scientists and lent advice to nuclear research centres in The Philippines, Korea, Indonesia and Thailand. Dr. Iyengar was given the Bhatnagar award in 1971 and the Padma Bhushan in 1975 for his contribution towards the Pokhran experiment. As chairman of the committee on advanced high energy accelerators he has envisaged development of synchrotrons in the country, both for basic research and advanced applications. [Text] [Bombay THE TIMES OF INDIA in English 8 Mar 84 p 5]

URANIUM FROM FRANCE--Prime Minister Mrs Indira Gandhi told the Lok Subha on Wednesday that one consignment of enriched uranium from France for the Tarapur reactors, had been received even as alternative mixed oxide fuel had been developed indigenously, reports PTI. She told Mr Ram Vilas Paswan in a written answer that the Tarapur reactors were the only reactors which required enriched uranium for fuel. [Text] [New Delhi PATRIOT in English 8 Mar 84 p 5]

TARAPUR SPARES--The government does not intend buying second-hand spare parts from old reactors in either the Federal Republic of Germany or Italy for the Tarapur atomic power station, the minister of state for external affairs said in a written reply. [Text] [Bombay THE TIMES OF INDIA in English 9 Mar 84 p 7]

N-POWER PLANT EQUIPMENT--New Delhi, Feb. 26.--The Atomic Energy Commission has asked the engineering industry to gear itself to provide the equipment and components needed to install a nuclear generating plant of 10,000 MW capacity in the period 1985 to 2000. Dr. Raja Ramana, Chairman of the commission, told the Association of Indian Engineering Industry at a special meeting, held last week at Kalpakkam, in Tamil Nadu, that plants for the installation had been framed. The commission outlined the detailed technical requirements, the time frame and the equipment and components required from the engineering industry to achieve the nuclear power target. The commission and representatives of the engineering industry agreed on a point action plant for the nuclear power programme in the coming decade. A national conference on this is to be organized later this year. The industry asked for the establishment of a Nuclear Power Development Authority, under the Department of Atomic Energy, with the responsibility of setting up nuclear power stations. [Text] [Calcutta THE STATESMAN in English 27 Feb 84 p 9]

RAMANNA ON NUCLEAR POWER--New Delhi, Feb. 26--Dr. Raja Ramanna, Chairman, Atomic Energy Commission (AEC), said today that India's nuclear power industry had come of age. "Both the department of Atomic Energy and the Indian nuclear industry are now poised to undertake the projected programme for installing a power generation capacity of 10,000 MW by the year 2000," Dr. Ramanna said at a get-together of senior scientists of the Department of Atomic Energy and a delegation of the Association of Indian Engineering Industry (AIEI) at Kalpakkam, 80 km from Madras. According to an AIEI release here Dr. Ramanna said that the entire cost structure of nuclear power would undergo a significant change with the reduction in the gestation period from the present 10 years, to seven to eight years. It would be a commercial demonstration plant which would be heralding a fast breeder programme involving setting up of two fast breeder reactors every year from the first decade of the next century. The fast breeder programme would ultimately lead to the use of the country's abundant thorium resources. Mr. M. V. Subbiah, AIEI president who led a 75-member delegation for talks at Kalpakkam, extended total support of the engineering industry for the nuclear power programme through supply of equipment, components and engineering services.--PTI. [Text] [Madras THE HINDU in English 27 Feb 84 p 9]

CSO: 5100/7060

EFFORTS FOR NUCLEAR ENERGY DEFENDED

Lahore THE PAKISTAN TIMES in English 3 Mar 84 p 4

[Editorial: "Pakistan's Nuclear Efforts"]

[Text] Director General, International Atomic Energy Agency (IAEA), Dr Hans Blix has given the lie to a lot of alarmist propaganda abroad by stating that his agency has not detected any diversion of the safeguarded nuclear material in Pakistan. That Dr Blix should pronounce clearly upon Pakistan's observance of the nuclear safeguards is especially useful in light of the fact that his own earlier statements in India had left the matter in some doubt. Additionally, IAEA has been itself under a cloud of suspicion in the West, particularly the U.S. where publicists have frequently lampooned it for being 'soft' on the countries that are embarked upon nuclear programmes in order to meet their energy requirements. The safeguard norms described by Dr Blix will put at rest all these doubts that have actually sprung from the political failure of the nuclear non-proliferation movement so close to the American heart. As for Pakistan, which has complained in the past that IAEA is spending more of its funds on inspection than on assistance to peaceful nuclear programmes, the latest expression of satisfaction about its safeguard observance will prove to be placatory. The problem in Islamabad is that hostile propaganda in the West tends to distract attention from real uses to which Pakistan's nuclear efforts are directed and ignores the crisis that our dwindling sources of energy threaten to bring about.

There are 340 nuclear power stations in the world accounting for 10 percent of the total world electricity production. In Europe, where nuclear power stations are coming up at a rapid pace, the percentage is 30. In Pakistan, the tasks of development and economic self-reliance are inextricably bound with energy targets. In another decade, the level of development projected will require the production of nearly 20,000 MW of electricity. If all the conventional sources in the shape of oil, gas and coal are quickly expoited--in itself an expensive and uncertain undertaking--they will yield no more than 10,000 MW. We can make up the shortfall by importing more oil but the cost will be stupendous. Already we pay 1.7 billion dollars for the oil we use losing half the foreign exchange we earn through exports. By the turn of the century oil is going to be more expensive when the world reserves are further squeezed. At present we produce only 10 percent of our requirement

of oil and it will be foolhardy to depend on this resource to feed a sector where the demand for energy is rising yearly at the rate of 17 percent. Pakistan used to burn a lot of coal in early years. In fact 22 percent of the needs were met with it but our coal is not of good quality and the available technology is not geared to its exploitation. Anyway, a National Coal Authority has been set up to speed up extraction of coal so that we can raise the use from the current level of a mere 2 percent. WAPDA is going in for more hydroelectric projects and is even exploiting small dams but once again the expansion in this sector is limited by natural factors like supply of water and geology. There is nothing for it but to go for a rapidly expanding production of nuclear energy. Hounded by foreign propaganda, we have not been able to work at the pace required. KANUPP produces only 137 MW and Chasma to begin in 1989, will produce 900 MW. That will leave us still 700 MW short of what we need currently. For survival, we must set up more nuclear power stations if only because they produce a lot of electricity at less than one-third the cost entailed by conventional means. IAEA and Pakistan have fortunately come to an understanding of these compulsions. Pakistan, on its part, has solemnly foresworn all designs of making a nuclear bomb and, as if to reinforce this undertaking, has agreed to accept a tighter regime of safeguards from IAEA. It is hoped that, being satisfied with these concrete assurances IAEA will assist with more funds the general energy-related projects and the various programmes that Pakistan Atomic Energy Commission is running in the fields of agriculture and medicine.

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MUNIR AHMAD KHAN DISCUSSES THIRD WORLD PERCEPTIONS

Lahore THE PAKISTAN TIMES in English 3-4 Mar 84

[Two-part article by Munir Ahmad Khan: "N-Power & World Cooperation--Perceptions of Third World"]

[3 Mar 84 p 5]

[Text] The views of the Third World have not been given adequate consideration in international nuclear policy-making because of its limited weight in economic, political and technological spheres. Nevertheless, the 155 developing countries of the world constitute nearly three-fourths of the world population and they are potentially a large user of energy, including nuclear energy. This continued disregarding of their views on nuclear energy development may not be a constructive approach towards evolving a stable world nuclear future.

Nuclear power itself is currently passing through a very difficult phase and the nuclear programmes of major industrial countries, particularly the United States, are at a standstill. This is partly because of the slowing down of national economies and partly because of strong opposition and pressures from certain groups expressing concern over the environmental impact of nuclear power and fears that the spread of nuclear power accelerates the proliferation of nuclear weapons. The attitude of several leading countries to nuclear energy has changed, and the United States, instead to being the foremost advocate, developer and leader in the area of nuclear power, as it was in earlier years, has assumed the role of the principal regulator controller and watchdog of the spread of nuclear power and technology throughout the world--a role that is far more difficult to play at this stage than perhaps is realised. In this process the United States has also lost its once commanding position and leverage on the world nuclear power scene. For similar, although not exactly the same reasons, there has also been a slowdown in the Canadian and West German nuclear programmes, Japan and France, in contrast, are still maintaining a considerable, though reduced, momentum in their respective programmes. With the prevailing gloom on the world nuclear power scene, it may be argued that if the technologically advanced countries are curtailing their nuclear power programmes, there is perhaps even less justification for developing countries to turn to nuclear power. Some even ask whether developing countries' interest in nuclear power

is because of the economic benefits or for other motivations. The answers to these questions can be found in the facts and figures on the energy situation in the developing countries.

Background

A large majority of the Third World countries are energy deficient and are net importers of oil. These developing countries are already spending about $74 billion annually on oil imports. The World Bank estimates that this figure is likely to double in real terms by 1990. Some of these are spending between 50 percent and 100 percent of their visible export earnings on oil imports alone, leaving very little for their pressing economic development programmes, for which they are thus forced to seek foreign loans. According to a recent estimate, in 1983 the total outstanding debt of the non-OPEC (Organisation of Petroleum Exporting Countries) developing countries will reach the staggering figure of $575 billion. The debt service alone on these outstanding loans will reach a figure of $100 billion. Under these circumstances, the developing countries are frequently forced to seek debt rescheduling, through difficult negotiations and at the expense of their long term economic and political interests. It can be argued that to reduce their crippling dependence on imported oil for meeting their energy needs, the developing countries should undertake the development of their own energy resources. In that context, it may be mentioned that a World Bank report has estimated that more than $450 billion (in 980 dollars) will have to be made available during this decade to support programmes that would help developing countries become self-sufficient in the energy sector. How this huge capital investment could be raised in the prevailing international financial climate is difficult to visualise.

Another factor that highlights the plight of Third World countries is the imbalance in the global energy consumption pattern. Whereas the average annual per capita consumption of electricity and commercial energy in the developing countries is only 350 kwh and 0.6 tonnes of coal equivalent (TCE), respectively, the corresponding figures for the industrialised countries are about 6,000 kwh and 6.5 TCE; in North America, these figures are still higher by a factor of two. The developing countries which constitute about 73 percent of the world population account for only 20 percent of world commercial energy consumption. On the other hand, the advanced countries, with only 27 percent of the world population consume 80 percent of the world's commercial energy. This large disparity in per capita use of energy in the developed versus the developing world is expected to continue well into the next century, as indicated by an international Institute for Applied System Analysis study. The developing countries will have to substantially increase their level of energy consumption if they are to achieve a reasonable economic growth in step with their urgent development needs.

There is a widespread misconception that the developing countries are rich in conventional resources of energy. The fact is that the energy resource base in most of the developing countries is extremely limited. These countries, which represent about three-fourths of the world population, account for only one-third of the known world reserves of fossil fuel. Out of these,

the Oil Importing Developing Countries (OIDC), with more than one-third of the world's population, have only one-sixth of the global reserves of fossil fuel. Contrary to general belief, the OPEC countries' fossil fuels are also limited, amounting to only 15 percent of the world total reserves. On a per capita basis, the OPEC reserves are only twice the world average and are considerably lower than those in the industrialised countries, particularly those of North America. As far as OIDCs are concerned, their per capita reserves of fossil fuel are alarmingly low, being less than one-fifth of the world average and one-thirteenth of the average for the industrialised countries.

The developing countries are also depleting their oil reserves at a much higher rate. In the next 20 years a number of OPEC countries (e.g. Ecuador, Gabon, Indonesia, Nigeria, Qatar, and Venezuela) will have nearly exhausted their known oil reserves. More than two-thirds of the fossil fuels produced in the developing countries (excluding China and other Socialist countries) are exported to the Western industrialised countries. This large-scale transfer of energy resources is, however, not matched either by adequate economic returns or by a commensurate transfer of energy technologies. It has been estimated by the Chase Manhattan Bank that the real rate of return on OPEC financial assets is between -2 percent and -4 percent annually, which would support the observation made in a World Bank report that "preserving oil can be more valuable than producing it."

[4 Mar 84 pp 5, 7]

[Text] (The first instalment of this article was published in these columns on Saturday).

Unless these OPEC countries can translate their rapidly diminishing non-renewable oil reserves into long lasting, such as the building of a strong, industrial infrastructure and the acquisition of technology and skills, their future prosperity and survival will also remain uncertain. Moreover, it is in the interest of all countries to ensure that precious non-renewable oil resources are not deleted rapidly, or wasted away, when other alternatives are available for electric power generation.

The economic consequences of the very high prices of fossil fuel which the developing countries must import for meeting their requirements have been disastrous. The inevitable increase in the price of the rapidly depleting, non-renewable fossil fuels will sharply increase the future energy import bills of the OIDCs and enhance their debt burden.

The United States was the first to use nuclear weapons and serious reactions among its intellectuals and scientists may also have influenced the government to take measures to restore its image at home and abroad. Whatever the motives behind the plan, it was without doubt a unique and commendable gesture. The end result of the Atoms for Peace plan was a large-scale and world wide transfer of peaceful nuclear technology. The United States trained thousands of engineers and scientists in its own laboratories and provided a large number of research reactors and other basic facilities to

several advanced as well as developing countries. Many developing countries took a keen interest in this new technology which offered both prestige in the near term and potential economic benefits in the long term. The net effect of the Atoms for Peace program was decidedly positive and far-reaching for the developing countries. Besides imparting to them know-how in nuclear research, it also acted as a catalyst for initiating a quiet but meaningful scientific and technological change in these countries.

Until the early 1960s, a key issue was banning the atmospheric testing of nuclear weapons. The two super-Powers were engaged in a race to develop increasingly powerful nuclear weapons and were testing them in the air, which was causing uncontrolled atmospheric pollution. At that time, nonproliferation had not yet emerged as a political issue. The Soviet Union had, in fact, strongly opposed the safeguarding activities of the IAEA that were being initiated at that time. With the entry of China into the Nuclear Club in 1964, however, the Soviet attitude changed radically and it was then possible for the two super-Powers to work together for the Non-Proliferation Treaty (NPT).

The NPT was primarily the work of the two super-Powers and at the negotiation and drafting stages, only the close allies on both sides were involved. Even the IAEA was not associated with this negotiation process. While the draft of the NPT was being analised the developing countries tried hard to bring about certain changes to make it more equitable and widely acceptable. A Conference of Non-Nuclear Weapon States (NNWS) under the aegis of the United Nations was organized in Geneva in 1968 to discuss their specific needs, particularly those for peaceful applications of nuclear technology and their security problems. The two super-Powers were unwilling to extend any tangible security assurances to the NNWS against nuclear threat or blackmail. The numerous resolutions adopted at the NNWS conference failed to make any impact on the super-Powers, which did not agree to the suggested modifications in the draft text of the NPT.

The NPT was supposed to be based on a quid pro quo consisting of a balance between certain obligations and privileges. The NNWS signatories to the NPT agreed to give up their nuclear weapons option in return for a promised fullest possible exchange of equipment, materials and scientific and technological information for the peaceful uses of nuclear energy, including the use of peaceful applications of nuclear explosions under strict international controls. The Nuclear Weapons States (NWS), for part assumed the role of nuclear guardians and in return undertook "to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament and on a treaty on general and complete disarmament under strict and effective international control" (Article VI). The Third World in general considers the NPT to be discriminatory. The NNWS parties to the NPT believe that promises given to them under the Treaty have not been kept. The developing countries, in particular, have not received the much-needed benefits of peaceful applications of nuclear technology. The transfer of technology has been reserved only for a few major industrialized countries and as a result, a special group of countries has emerged that is considered entitled to receive the so-called

sensitive nuclear technology; the rest are not "trusted" in spite of their unquestionable commitments to the NPT. The NWS have not taken any steps toward actual reduction in their nuclear stockpiles. Instead, there has been an unabated race toward increasing the quantity and quality of the nuclear weapons which has led to the development of new weapon system with ever greater destructive power, strike accuracy, and deployment flexibility. The recent estimated 50,000 nuclear warheads with a total destructive power equal to many tons of TNT for each living person is an awful reminder of the utter failure in taking effective steps toward nuclear disarmament. This constant escalation in vertical proliferation, which, in fact, constitutes an immediate threat to world peace and security, is being downplayed by the NWS. Instead, a disproportionately large amount of energy and effort is being spent on voicing concerns about the supposed threats of horizontal proliferation in the NNWS that may not materialise. As Kenneth N. Waliz has observed: "Nuclear weapons have only proliferated vertically horizontally, they have spread slowly and the pace is not likely to change much."

The de facto position is that the NPT has been virtually "rewritten" and is being interpreted to suit the interests of the NWS, which use the Treaty to put additional restrictions on the NNWS regarding acquisition of so-called sensitive technologies, including enrichment and reprocessing in complete contradiction to Article IV. Exceptions are rationalized in cases of allies and friends where it suits the concerned NWS. Under these circumstances, the NNWS signatories to the NPT are deeply distressed at this new form of discrimination within the community of NPT signatories.

The NPT is half-way through its original 25-year life and there is growing dissatisfaction among signatories of the Treaty. Most of them feel that the bargain has not been kept. According to Ian Smar, "the substantial benefits which the NPT was designed to confer upon NNWS who signed it have not been forthcoming. Nuclear suppliers have eroded the Treaty and repairing it will take many years." Strong disagreements have arisen on the implementation of the Treaty among its adherents, as reflected in the Second NPT Review Conference of 1980 which could not issue an agreed-upon communique. The year 1995, when the NPT comes up for extension is not very far away and unless the NWS take effective measures to restore confidence in the NPT through nuclear disarmament and to honor the pledges given to NNWS under the Treaty further problems may arise. It would then be difficult to give a new lease to the Treaty.

The current situation in which many signatories to the NPT feel that they have been left with only a set of obligations, without realizing any real benefits from the bargain has discouraged additional countries from considering signing the Treaty. A liberal and purposeful sharing and transfer of technology for accelerating the development of the NNWS could act as a strong incentive for lending wholehearted support to the NPT.

Erosion of Confidence

The Indian underground nuclear explosion in 1974, declared to be peaceful by India, proved to be a decisive landmark in the rethinking of nuclear policy. The NWS instead of analyzing this event objectively and understanding its technical strategies, and political implications, chose to stress controls and denial of access to technology as the primary measure for stopping any further spread of nuclear weapons capability. This led to the creation of the London Suppliers Club. The comprehensive London Club guidelines were extremely difficult to implement and, at the same time, compelled the affected countries to develop indigenous capabilities more quickly than could be imagined. The resulting frustration among the supplier states has increased pressures for devising even more complex and detailed lists of items to be embargoed. This is resented by certain members of the London Club who have expressed their inability to enforce the embargoes because of the high cost of implementation and because of the practical difficulties due to the multiple use of most of the items involved. They also agree that such a policy will only ensure an accelerated development of alternative sources of supply through greater indigenization and cooperation among Club non-members. The fact of the matter is that basic nuclear technology has already spread and it is now possible for any country in the intermediate stage of industrial development to acquire the wherewithal and know-how that were available to only a few countries 30 years ago. With worldwide communication and ease of exchange of information the time lag between the development of a new industrial process and its availability has been dramatically reduced and will continue to become shorter and shorter. We cannot expect to halt the spread of knowledge through the simplistic approach of applying technical fixes because it will not work in the face of the irretrievability of the know-how that has already spread and the inevitability of new technological advances that will overtake and in due course, render irrelevant any technical or mechanical barriers that we may try to erect. The developments over the last few years during which international nuclear trade has been made a victim of "ad hoc-ism" and unilateralism, have resulted in the discovery of more uranium (for instance, in Brazil and Peru), and even more countries have opted for complete or partial self-sufficiency in the nuclear fuel cycle (including Argentina, Brazil, India, Israel, Pakistan, South Korea, etc). As Karl Kaiser, Director of the German Society for Foreign Affairs has put it: "Under conditions of an increasingly eroded monopoly of nuclear technology an exaggerated policy of technology-denial can lead to a direct threat to the non-proliferation regime... Given the growing independent technological and scientific capacity of the Third World non-proliferation policy will have to shift its chief emphasis from export control to co-operation with these countries more than it previously has in the field of nuclear science and technology."

Many advanced countries which were suppliers of nuclear technology realized the implication of the trends generated by this policy of denials and gave support to an idea of allowing an international body, such as the IAEA to look into the norms regulating the supply of nuclear materials, equipments and services. A Committee on Assurances of Supply (CAS) was thus formed by the IAEA Board of Governors and was made open to all members of the Agency.

The task of this Committee is to consider and advise on "ways and means in which supplies of nuclear material, equipment, technology and fuel-cycle services can be assured on a more predictable and long-term basis in accordance with mutually acceptable consideration of non-proliferation." The Committee has had several useful but still inconclusive meetings. Unless there is a basic change in the attitude of the more important supplier states no quick resolution of the problem is in sight. Similarly another technical study on the proliferation potential of various nuclear fuel cycle strategies, called the International Nuclear Fuel Cycle Evaluation (INFCE) was launched in October 1977 to help resolve the controversy surrounding the reprocessing and plutonium economy concepts in power generation. It concluded that reprocessing was, in fact, economically advantageous, that recycling of plutonium in power reactors was a safe method of disposing of it, and that nuclear technology for power generation was not the only or even the preferred route to proliferation. The final communique of INFCE stated "that nuclear energy is expected to increase its role in meeting the world's energy need and can and should be widely available to that end; that effective measures can and should be taken to meet the specific needs of developing countries in the peaceful uses of nuclear energy; and that effective measures can and should be taken to minimise the danger of the proliferation of nuclear weapons without jeopardising energy supplies or the developments of nuclear energy for peaceful purposes."

Even before the closing of INFCE and thus before the prospective recipient countries could derive any satisfaction out of the conclusions of this unprecedented and comprehensive study, the adoption of the U.S. Nuclear Non-Proliferation ACt (NNPA) of 1978 dampened the hopes of any liberalisation of nuclear trade. The provisions of this Act, according to many observers, were actually contrary to the terms of reference of INFCE and also undermined the assurances given to the recipient countries under the NPT.

The NNPA established new nuclear export criteria for the foremost nuclear suppliers, specified conditions resulting in termination of U.S. nuclear cooperation, defined the norms for obtaining approval for reprocessing and gave the requirements for negotiating all U.S. agreements for cooperation. For the first time, national legislation was adopted to enable a country to make changes in international treaties and agreements. The recipient countries were asked either to sign the NPT or to accept full-scope safeguards. The NNPA introduced the right of "prior consent" or veto on the reprocessing of fuels supplied by the United States or irradiated in a U.S. reactor. It is perhaps the most restrictive legislation of its kind and it has had far-reaching international implications. On balance, it has reduced the ability of the United States to influence the nuclear policy of the rest of the world and instead of strengthening U.S. leverage, has served to diminish it. As former U.S. Ambassador Gerard Smith has stated, "the most serious flaw in U.S. policy has been its emphasis on unilateral denial of nuclear materials as a form of leverage to prevent proliferation." Similar practices of retroactive application of national legislation or policies have have been adopted by other countries. The resultant forced negotiation of valid agreements has undermined faith in international nuclear co-operation, eroded the sanctity of nuclear treaties and created a sense of insecurity

among the recipient states, either developed or underdeveloped. By persisting in this policy the supplier states have acted contrary to the advice of Justice Sir Roger Parker, head of the Windscale Enquiry of 1977 who said that he did not believe that the best way to conclude a new contract was first to break an existing one.

There have been some other instances as well that have led to the erosion of confidence of the recipient states in the reliability of the international co-operation agreements. This has greatly diminished the credibility of the supplier states and has created a deep sense of insecurity among the recipient states. The natural reaction has been a lack of mutual trust and development of indigenous technologies as an insurance against supply uncertainties in the future. Specific instances of this include the revision of Canadian contracts with Western European countries, Japan and its other partners in the nuclear trade. In certain cases, renegotiations with specific countries in the light of the NNPA has resulted in anomalies and the resorting to make shift arrangements to avoid political difficulties. France, which is generally credited with an independent policy did not honour some of its agreements and is now trying hard to restore its image as a relatively reliable partner in the nuclear trade. The supplier states expect the recipient states to remain fully bound to their safeguards and other bilateral commitments, but feel they themselves can revoke their own undertakings at their own convenience. They do not recognize the irrevocable safeguards have to be linked to irrevocable supply guarantees.

Perceptions of the Third World

In the light of the foregoing, it is easier to understand the general perceptions of the Third World countries on some of the vital issues concerning international nuclear co-operation. The Third World countries represent a wide spectrum of states and their reactions to international nuclear relations are not always identical. Most of them are signatories to the NPT; some are economically and industrially better placed; a few are exporters of energy while most of them are grossly under-developed and short of indigenous energy resources and technologies. The general reactions to the basic issues of energy and proliferation are very similar, however, and these can be summed up as follows:

Energy. The developing countries feel that the international community has shown very little concern or interest in understanding and helping resolve their acute energy problems, which are paralyzing their economies and threatening their survival. The rising cost of energy and growing uncertainty in its supply have undermined their economies and have created serious balance-of-payment difficulties. They are seriously concerned about their energy supplies and consider nuclear power to be an economic and viable alternative for meeting their power needs. They hope to see greater use of nuclear power in the advanced countries to relieve the pressure on diminishing world resources of oil and to avoid further escalation in oil prices. The developing countries feel that the rich industrialised countries are effectively pre-empting the available chieap fuels such as oil by delaying the introduction of energy conservation measures and by cutting down the

nuclear power programmes which could save the precious fossil fuels and that they are not sharing with the developing countries the energy technologies that could bring some relief.

The Third World countries would welcome better recognition of the key role of nuclear power in staving off a deeper and paralysing energy crisis. They believe that instead of relying on fond hopes about any early advent of soft technologies for quickly rescuing the world from energy shortages, serious attention should be paid toward making nuclear power safer and economically and technically more accessible for widespread use under appropriate safeguards and safety regimes. Toward that end, there is a case for developing standardised, medium-sized power reactors that could be operated in needy developing countries and technically serviced through international arrangements to ensure their proper and efficient operation.

Proliferation. The third World countries are conscious of the fact that prevailing fears about proliferation of nuclear weapons are the greatest obstacle to their acquiring nuclear technology for peaceful purposes. It would, however, be sensible to analyze this important problem in an objective manner and not let the alarmist attitudes and technically unsound arguments put forward by certain quarters decide policy issues.

Nuclear proliferation is basically a political problem. The reasons for the proliferation of weapons, including nuclear, are linked with perceptions of security needs and national interest. The acquisition of nuclear weapons by developing countries would not enhance their security. Instead, it would expose them to threats of a direct nuclear action by others against which they would have no viable defence. And should a developing country decide to acquire nuclear weapons, it would inevitably put an almost unbearable economic burden on that country and cause serious social and political problems within its own borders where generally a large segment of the population is deprived of even basic necessities of life. Any objective analysis would indicate that this would be too high a price to pay for a nuclear weapons capability of doubtful effectiveness.

Developing countries want to retain the so-called nuclear option. It is basically for political reasons either as a reaction to the discriminatory nature of the attitude of the NWS as formalised in the NPT which most of the Third World countries regard as one-sided or in the belief that it would give them a leverage for strengthening their negotiating position in security matters. It is quite obvious that the rational way to remove these incentives is not through technical fixes, but rather by addressing directly, at the international and regional levels, the political issues involved. Only then can we have some hope of making headway toward the solution of this thorny problem. A British foreign secretary, quoted by Sir John Hill, summed it up as follows: "There is a direct link between removing the incentive to acquire nuclear weapons and the creation of conditions of stability and security. The reverse of the case is a recipe for nuclear conflict. The quantitative threat of proliferating nuclear weapons can nonly be contained by a qualitative improvement in the management of international relations."

The Third World believes that the NWS have eroded their moral right to advocate non-proliferation for others, because it is these very countries that are engaged in an uncontrolled race for vertical proliferation. The nuclear arsenals of the major powers are well beyond their legitimate requirements and the increasing stockpiles not only push them towards confrontation, but also create increasing insecurity for the world as a whole. The overwhelming majority of mankind will neither be consulted nor listened to and their fate will be decided by others. What makes the preaching of the weapons states even less persuasive is the fact that they are selective in their behaviour towards the others. They have one attitude towards their close allies and client states and another toward the rest. This "partiality" gives the impression that they tend to play politics with the all-important issues of non-proliferation and that their non-proliferation stance is not guided entirely by considerations of world peace and security, but rather for advancing their own political interests in different regions of the world.

One of the crucial factors inhibiting the wider use of nuclear technology for power generation is the fear of many policy-makers that nuclear power reactors are a source of materials that can be used for making nuclear weapons. They link the growth of nuclear power directly with the increase in proliferation of nuclear weapons. They assume that this would enhance the chances of these nuclear weapons materials falling into the hands of irresponsible persons and terrorists, with resultant enormous risks for all. This scenario has a substantial appeal for the general public and for certain policy-makers. The fact is, however, that there is no linkage between nuclear power plants and nuclear weapons. At best, nuclear power is of peripheral significance in relation to a nuclear weapons programme. It is extremely difficult for any country or any group of persons to divert significant quantities of nuclear material from an internationally safeguarded power reactor. Second, the manufacture of a reliable nuclear explosive devide from reactor-grade plutonium is most risky, if not impossible. Only nuclear weapons states with extensive test data and years of experience on designing and manufacturing sophisticated nuclear devices have the capability of doing so. In the light of these considerations, the fears that a small band of terrorists could accomplish this technical feat are not well founded. As Bertrand Goldschmidt has put it, "Despite the wide diffusion of data relating to the less sophisticated atomic weapons, it remains practically impossible to manufacture a nuclear bomb by make-shift methods, a task 'as difficult as building a space rocket at home.'"

Energy security is a serious problem not only for the affluent countries, but even more so for the developing countries which are just embarking on their national development programs and which require large in-puts of energy for building base infrastructures. It is becoming imperative that we broaden our perspective and seriously work toward evolving a global energy policy to ensure optimum utilisation of available limited oil and other fossil fuels, and for unorderly introduction of nuclear energy and a speedy development of other energy technologies for the future. Recognition of global energy interdependence is indispensable for resolving the world energy crisis.

Proliferation of nuclear weapons is basically a political problem. It is essential now to have a fresh look at and take some courageous initiatives for resolving this problem. We should make a rational distinction between the development of nuclear power under IAEA safeguards and the perceived threat of proliferation. Unless we can manage to make that distinction we will succeed only in depriving the world of the benefits of nuclear war without advancing the cause of non-proliferation.

Most of the so-called threshold countries are amenable to a constructive political dialogue to help develop a new nuclear order that recognizes the existence of major nuclear powers or at least the two super-Powers as a reality; they want to participate in the process of preserving not only their own security but also the safety of mankind.

We should break away from the prevalent thesis that the two super-Powers are the repository of all the wisdom, because they have nuclear arsenals and that the smaller and poorer countries which badly need nuclear power are devoid of all considerations for the safety of mankind. Many of these countries have in fact expressed willingness and support for the establishment of nuclear weapons-free zones in their respective regions. Their views on this matter deserve serious consideration since they could make a very positive contribution to the cause of non-proliferation.

The policy of denial of nuclear technology and of using technical fixes to promote acceptance of non-proliferation has not worked and, in fact, has been counter-productive. It should give way to a more statesmanlike approach based on co-operation rather than confrontation. A policy of sharing peaceful nuclear technology and encouraging inter-dependence is likely to be much more successful and will create a feeling of mutual trust and confidence. The existing insecurity of supplies has actually encouraged the proliferation of the nuclear fuel cycle and has compelled countries to seek a greater degree of self-reliance in the nuclear field. The countries that have been forced to achieve a certain capability on their own are less likely to give it up under coercion than through persuasion and evidence of concrete benefits for their nuclear power programs.

IAEA safeguards are basically sound and provide credible assurances. There have been no instances of noncompliance with Agreements or diversion from the facilities under the Agency safeguards. It would be extremely difficult, if not virtually impossible, for any country to divert significant quantities of fissile materials without timely detection and if it attempts to do so, it cannot face the formidable adverse international public opinion and attendant serious consequences. It is imperative, therefore, that we work together in supporting the Agency in its dual role of promotion and regulation of nuclear power with equal vigor and emphasis.

Every available opportunity should be used for conducting a serious dialogue between the Third World and the advanced nuclear countries to understand each other's perceptions and to narrow down existing differences. Both should be credited with genuine interest in evolving world nuclear order. In this connection, it is important that a conference already approved by the United

Nations for the Promotion of International Cooperation in the Peaceful Uses of Nuclear Energy, be held. This conference could serve as an important forum to cover political, technical and economic questions and for creating a climate of confidence among the parties concerned.

There is an urgent need for the rethinking of all the important issues pertaining to nuclear power and non-proliferation. We should realize that the problems of world security are indivisible and that no single nation or group of nations can enjoy security and prosperity at the expense of or without the cooperation of an overwhelming majority of the world population.

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PROPAGANDA AGAINST PAKISTAN ANALYZED

Lahore NAWA-I-WAQT in English 16 Mar 84 pp 7, 6

[Article by Dr F. Hassan: "An Analysis of Propaganda Against Pakistan's Peaceful Nuclear Programe"]

[Text] The first and only nuclear weapons used against Japan in 1945 were those dropped by the so-called most civilised country, the USA, killing almost 150 000 people. Since then, though luckily, no atomic bombing has taken place, the arms race has continued unabated. The wishful thinking of the USA to be alone to dominate the world with an arsenal of nuclear weapons was shattered within 4 years of testing the first nuclear weapon, by the Russians. Production of Atomic Bombs was followed by Hydrogen Bombs. The nuclear arms race was not confined to the USA and the USSR. Within a short span of time the United Kingdom and France joined the exclusive club and mastered the technlogy of making nuclear weapons. Peoples Republic of China, feeling threatened by the USSR and the USA, also embarked upon this program and surprised everybody by exploding both the Atomic Bomb and the Hydrogen Bomb in a short span of 3 years in the early sixties. The biggest surprise was pulled by the so-called exponent of non-violence policy, India, by exploding a nuclear device, purportedly for peaceful purposes. The Plutonium was obtained from irradiated local fuel clandestinely using the Canadian Cirus Reactor and reprocessing it. Since May 18, 1974 when India exploded her nuclear bomb for all practical purposes, no new state has joined openly the nuclear club consisting of the USA, UK, France, USSR, China (and India). Israel has also manufactured and stored a large number of nuclear weapons. In this context the statement of the Israeli President and the CIA Report, both given below, are of great importance:-

"It has always been our intention to develop a nuclear potential. We now have that potential." E. Katzir--President of Israel Dec 1974

"We believe that Israel has produced nuclear weapons." CIA (USA) Sept 1974

The main nuclear rivals, the USA and the USSR, (and to a lesser extent the UK, France and China) have stockpiled hundreds of thousands of nuclear weapons in all sizes and strength. They can destroy the whole world many a time over. They are still engaged in mass production of these weapons and also of regular testing of them. According to a recent report, the Americans

are producing 8 nuclear weapons a day and have more than 26 000 warheads deployed. A great variety of circumstances, created intentionally or arising unintentionally, may trigger the use of nuclear weapons. The probability of such an occurrence, though may be very small, is not zero and still follows "Humphreys' Law."

The hypocrisy of this whole exercise is the attitude of the nuclear giants towards developing countries. By forming an exclusive club, they are monopolizing the transfer of nuclear technology to energy starved third world countries under the pretext of containment of nuclear weapons or non-proliferation. The control or restriction are relative, when it relates to Israel, India, South Africa, Brazil and Argentina, all out assistance is provided at government level and no stories or leakages are provided to the national or international press.

The situation is quite different when it matters the Islamic countries. The world-wide propaganda organised by the western lobby in general and the Jewish lobby in particular, against Pakistan, Libya and Iraq has put to shame the campaign carried out against Hitler in war days. The BBC Panorama film, 'Project 706--The Islamic Bomb, Panorama Updated, the book entitled, "The Islamic Bomb," and thousands of articles, TV programs have all been aimed against the Muslims. And the villain is, of course, Pakistan. In spite of all our support and association with the Western countries, we are still the naughty horse to be whipped. Why this hypocrisy and double standard with us? The answer is simple. The Crusade is still on. Islam is the only religion which tore apart the ignorance of the West and threatened to finish it once for all. The Muslims spreading from Morocco to Indonesia are a formidable force (if properly organised and industrialised with unlimited wealth and manpower). To perpetuate their backwardness and dependence on the Western world exactly fits in the well thought-of strategy carved out by these Western countries.

Since of all the Islamic countries Pakistan has been marked singularly, and is on the hit list, let us analyse the whole matter systematically.

To start with, we are always rubbed against our face with the statement of the late Prime Minister, Mr Bhutto, who in the heat of the then existing circumstances in 1965, emotionally had said:

"If India builds the bomb, we will eat grass or leaves, even go hungry. But we will get one of our own. We have no alternative."

It was easier to make the statement than to make the bomb. Pakistan did not have the technology, the resources or the manpower to do the job. It still has a very limited option but for the last 5 years lot of prophecies have been made of the impending detonation of a nuclear bomb by Pakistan. Let us look at what is involved to be able to make a nuclear bomb--a simple atomic bomb.

Only two fissile materials, viz Uranium 235 (or U-235) and Plutonium 239 (Pu-239) are capable of being used for the construction of a nuclear bomb. The technology to obtain U-235 or Pu-239 in sufficient quantity is a herculean task. It is an extremely complicated and well-guarded secret. And when the fissile material is available it is still a herculean task to design and manufacture a workable nuclear weapon. The basic principles of an atomic bomb are given in the box, but it is not as simple as it looks in the sketches. Let us now have a look at the ways and means of obtaining the fissile materials, viz U-235 and Pu-239.

1. Production of U-235

Natural Uranium contains only 0.7% of U-235 and the rest is U-238; that means out of 140 atoms of natural uranium only one atom is of U-235. The identical chemical properties and a miniscule difference in molecular weights of the two isotopes makes it very difficult to separate U-235 from U-238. The two well-known methods are the diffusion method and the centrifuge method. Diffusion method has been used by the USA, USSR, England, France and China to produce weapons grade material. The centrifuge method is a new comer but is well-established and though plants producing reactor grade material (3 - 3.5% enriched) are openly operational, there is no information if this technology is being used for weapon's grade material by any country.

a. Gas Diffusion Process

In diffusion process, gaseous uranium hexaflouride is compressed in axial compressers and fed to the so-called converters which contain a cooler, to remove compression heat, and a large number of porous tubes. In the space around the porous tubes, a vacuum, maintained by the compressor of the separation stage, causes some of the UF_6 to diffuse through the porous tube walls. In this way the lighter molecules become enriched in the diffusate because of their higher average gas velocity. This occurs due to collision of molecules with the wall when migrating through the pores of the membrance. Collision among the particles does not occur as otherwise it would cause the heavier and lighter molecules to push each other in the pores rendering the separation impossible. While the gas enriched in U-235 is fed to the converter of the next stage after compression, the depleted residue flows to the compressor of a preceding stage. Since the residual fraction is at a higher pressure level than the fraction that penetrated through the pores tube wall, the compressors are provided with 2 suction converters maintained at different pressure levels. The diagram shows the principle of this process.

Some 1500-2000 diffusion stages are required in series to produce 3.5-4% enriched material used in light water reactors. More than 4500 stages are required to produce 90% enriched material needed for nuclear weapons. Only the USA, USSR, England, France and China have diffusion plants to produce both reactor grade and weapon-grade materials. The process is highly complicated and expensive requiring many years of hard work and billions of dollars. Naturally, Pakistan is nowhere in this field and that is why nobody has ever accused Pakistan of even trying to put up a diffusion plant for the enrichmment of uranium.

b. Gas Centrifuge Process

The gas centrifuge process was first used in the USA by Prof Beams and in Germany by Profs Martin, Beyerle and Hartek during the second world war on a laboratory scale but had to be stopped because expertise in metallurgical sciences was not able to cope with the demands of the centrifuge rotors. Work was started in the sixties and now the UK, Germany and Holland have operational plants with Japan joining recently with a small pilot plant. The USA is putting up a $10 billion plant at Portsmouth, Ohio. The diagram given shows a centrifuge design. The rotor of the centrifuge is supported on a steel ball and is held at the top end by two axially opposed ring magnets so that there is no contact and thus no bearing friction. The rotor is driven at the bottom end by an eddy current motor at 75 000 to 80 000 rpm, using a high frequency inverter. The interior of the rotor is connected to the ambient space at its top end through the circular hole between the ring magnets. The UF_6 gas is fed from the top to the centre of the machine when the pressure is very low. However, in order to restrict the gas friction of the rotor to minimum, the UF_6 is kept away from the bottom section of the rotor by a molecular pump or a seal. The removal lines for the enriched and the depleted fractions are designed as stationary tubes. The upper system of the feed and collection tubes is used at the same time to generate a convection flow in the axial direction which multiplies the elementary separation effect. A centrifuge plant has many advantages over a diffusion plant and needs only about 15-16 stages to prepare reactor grade material and about 70-80 stages for weapons grade material. Moreover, centrifuge plant can be built stepwise and expanded as/when desired. It is these advantages that make the centrifuge process so attractive. However, the design and production of a centrifuge, and then to put up a functional industrial plant is a gigantic and herculean task. The work started in Pakistan by our own world-renowned, and legendary-in-his-lifetime Dr A.Q. Khan is something monumental. Even though the western countries and news media have been engaged in the most ferocious and mischievous propaganda against Pakistan's peaceful nuclear program and are talking as though Pakistan has already manufactured and stockpiled a huge nuclear arsenal, we must take it with a pinch of salt. No doubt we have done an excellent work but, knowing the extreme sophistication and complication of a centrifuge plant, it will probably take some time before we can produce enough quantities of 3% (reactor-grade) material, not to talk of the 90% (weapon-grade) material, if the Government decides to go ahead at all. So far, the President and Dr A.Q. Khan have both categorically denied any intention or attempt of making nuclear weapons. The fact, however, remains that once the hard nut of low enrichment is cracked, the harder nut of weapon-grade material will be available in a short time, if the Government so desired. The capability is thus available once a low enriched facility is made operational. It is because of this capability created by Dr Khan that the International Herald Tribune recently referred to him as the real father of Pakistan's nuclear program.

2. Plutonium (Pu-239) Production

Pu-239 is not a natural element. Heavy isotopes like U-235 undergo fission after capturing either a slow or a fast neutron and are called fissile materials. Pu-239 is produced when U-238 nuclei (in reactor fuel) absorb slow neutrons. The U-239 nuclei so formed do not undergo fission but are ultimately transformed into Pu-239 with an atomic mass number 94. Actually U-239 nucleus decays by emitting an electron; the emission of an electron occurs when one of the neutrons in the radioactive nucleus spontaneously changes into a proton. A new element is formed by this fascinating event since the new nucleus contains an additional proton. Thus, when U-239 decays, an isotope with an atomic number of 93 is produced, namely Neptunium-239 (Np-239). And Np-239 is also radioactive undergoing beta decay (electron emission) to produce Pu-239.

$$92\ U_{238} \xrightarrow{vn} 92\ U_{239} \xrightarrow[23.5m]{8} 93 \xrightarrow[2.35d]{Np239} \xrightarrow{8-} 94\ Pu\text{-}239$$

Radioactive nuclides are characterised by their half-lives, the time taken for half of a large number of radioactive atoms to decay. Pu-239 is radioactive with a half-life of 24 000 years when U-239 and Np-239 have short lives of only 23 months and 2-3 days respectively. Pu-239 decays in a different manner to U-239 and Np-239. Instead of emitting a beta-particle it shoots out two protons and two neutrons tightly bound together and this composite entity is known as alpha particle. The nucleus left after this process is U-235. But if the Pu-239 nucleus captures a neutron before it decays in this manner it will undergo fission and it is this property which has made Pu-239 the most sought-after and dangerous material for the manufacture of nuclear weapons.

The Pu-239 required for the Manhattan Project was produced by uranium-graphite reactors built at Oak Ridge and Hanford. Slightly burnt (irradiated) fuel from these reactors was reprocessed in a Reprocessing Plant to obtain the fissile Pu-239 for 'The Fat-Man.' The reprocessing technique is a rather sophisticated process and is well-guarded because of the weapons implications.

The composition of the burnt fuel depends on the burnt-up time, the heat generated in the fuel (power rating) and the time elapsed since the end of irradiation etc. The Reprocessing Plant is meant for recovery of unburnt uranium and plutonium. There are number of techniques (viz Bismuth Phosphate Process, Redox Process, Trigly Process, Butex Process, Purex Process, Thorex Process Pyro-chemical Process, Fluoride Volatility Process etc) for reprocessing the spent fuel to obtain pure uranium and plutonium. The purified plutonium can either be converted to plutonium oxide for fuel in a reactor or as metallic material for nuclear weapons.

Following India's secret development of an atomic bomb in 1974 (Explosion on May 18, 1974) the US Government spearheaded a campaign to stop the delivery of the reprocessing plant by France, to Pakistan. We were forced to pay for India's deeds.

3. Reprocessing Plant for Pakistan

After almost 3 years of hectic and unnecessary lengthy discussions on the part of Pakistan, a protocol was signed on 16.3.1976 between SGN of France and Pakistan under IAEA supervision under which France was to provide Pakistan with an industrial reprocessing plant. Till today one is at a loss to understand the logic behind the advice given to the then Prime Minister about purchasing this white elephant for about $300 millions (projected cost on completion). We did not have any power reactors except KANUPP or enough fuel to reprocess and if someone was giving the impression that the reprocessing plant was a magic wand for making nuclear weapons he was taking the government for a ride. The basic fallacy and limitation of the deal was immediately obvious to the Americans that the reprocessing plant made no sense technically or economically in Pakistan's still limited nuclear power program but had seeds of a decisive military option. Under constant, severe pressure from the USA, the French backed down finally from the deal on June 15, 1978. In the history of nuclear energy one never saw such a sustained and vehement propaganda mounted against anything as against Pakistan's reprocessing plant. The Western world, spearheaded by the USA, the Israelis and the Indians all went for our blood even though they knew fully well that the said plant did not pose the slightest threat to anybody and was not able to give Pakistan any benefit or capability of making a nuclear device, even a hypothetical one. To put the last nail in the coffin, President Carter cut off $40 million development aid to Pakistan in August 1978.

4. Basic Limitations

There are so many hitches and limitations in the whole program that one is really at a loss as to understand the motives of the vehement propaganda against Pakistan. To start with we must identify the basic facilities needed to be able to make a nuclear device. We must have:-

a. A Production Reactor (i.e. a reactor capable of producing plutonium).

b. A Fuel Fabrication Plant.

c. A Heavy Water Production Plant.

d. A Reprocessing Plant.

And above all, all these things must be outside the IAEA safeguards. If we look closely at Pakistan's capability we know that:

(a) We do not have a Plutonium Production Reactor--inside or outside IAEA safeguards.

(b) The Fuel Fabrication Plant. Pakistan's fuel element production capability is trivial. According to all available and reliable sources Pakistan is not able to make a full load (2280 assemblies each containing 19 elements) in even 20-25 years. And even if we made it, what could we do with it? The plant ordered by Pakistan from Canada was stopped under US and Canadian collaboration, by Canada from shipment in Dec 1974 as a punishment to us for the mischief done by India on May 18, 1974.

(c) We do not have a heavy water production facility to replenish the loss of heavy water in KANUPP. If we buy it from someone, the safeguards already in force on KANUPP will be doubled.

(d) It is an open secret to all who are anybody in the nuclear field that after France unilaterally abrogated the reprocessing plant deal, we are left high and dry. The very small experimental laboratory (New Labs) bought from Belgonuclear is no more than a child's play and may be capable of, it at all, producing a few milligrams of Pu-239 per year, according to all published and available data. However, according to all evaluations by the international experts, the facilities at New Labs, near PINSTECH, have not been operational or in a position to do even the trivial task being attributed to it.

5. KANUPP and Plutonium Production

KANUPP is a CANDU-Type Reactor and theoretically is capable of producing rods with the needed short burns (for Pu-239 production) while in continuous operation. In practice, however, low efficiency means just low efficiency and not that low burn-up rods (with minimum poisonous Pu-240) are being produced. Based on some simple mathematical calculations, Pakistan must steal or divert at least 1700-1800 fuel elements to obtain enough material for a single Plutonium Bomb. According to the IAEA, KANUPP's normal refuelling rate is 4 assemblies (fuel elements) per day and it would necessitate almost 20 years of successful stealing or diversion, which is not only impossible but even unimaginable, given that the IAEA has accounted for all fuel rods so far used in KANUPP. The presence of cameras and computers used for monitoring fuel bundle insertion and withdrawal makes it virtually impossible to remove any burnt up fuel without being caught.

Technically, KANUPP working at about 60% efficiency with full core-loading of about 28 tons could theoretically breed about 50-55 kg of plutonium but this is about 25-30% contamination with undesirable and poisonous Pu-240. To bring this contamination down to very low level, the reactor must run at a very low efficiency which would automatically result in very low production of plutonium. KANUPP has been running at a very low efficiency since the Canadians stopped fuel, heavy water and spares and has been standing idle most of the time. What all this means is very clear: even if Pakistan breaks safeguards today and runs KANUPP at 20% efficiency it would take a minimum of 10 years to get enough weapon grade plutonium, assuming a full core-loading. If it is run at 5% efficiency it will take 20-25 years to accumulate enough material for a single bomb, still all under stringent IAEA safeguards.

6. IAEA Safeguards

The facts about KANUPP are, however, like an open book. IAEA Inspectors have been counting all the fuel rods obtained from Canada. They have found them sealed, duly marked and complete in number. No diversion has taken place. Production or insertion of our own fuel rods at a trivial rate did not change the situation at all as the safeguards were upgraded the moment we started production of a few fuel elements and made a big publicity at

international level by calling a press conference on Aug 31, 1980 at Karachi. These few fuel rods are now loaded under IAEA supervision. The acceptance by Pakistan of additional surveillance of the emergency air lock closed all real or imaginary source of fuel rod diversion or stealing. The IAEA has now confirmed that there has been no, repeat NO, diversion of any spent fuel from KANUPP since its commissioning. Contrary to the Jewish lobby, and the vested western press media, no possibility of diversion or stealing of spent fuel from KANUPP has ever existed and thus no possibility of making a nuclear bomb by Pakistan.

7. Technical Hurdles

1. Once we explained that it was impossible to divert or steal burnt-up fuel rods from KANUPP we could get down to the heart of the whole thing. The foremost difficulty in making a plutonium bomb comes from the plutonium obtained from a power reactor. Contrary to many theoretical suggestions of many nuclear scientists, no country except the Americans (and that claim too, one must take with a pinch of salt), have succeeded in exploding a bomb out of a power reactor-grade plutonium in 1977, and that too contained less than 12% poisonous undesirable Pu-240. Pakistan has never run KANUPP for producing weapon-grade plutonium and all the fuel lying in the pool has a high Pu-240 concentration making it completely unsuitable for weapons production. Moreover, according to all domestic and international (including IAEA) reliable sources, NO hot runs of Pilot Reprocessing Plant have as yet taken place at PINSTECH.

India's former Chairman of the Atomic Energy Commission Dr H.N. Sethna was sure that Pakistan was not at-all capable of staging even a crude test. Dr Usmani, former Chairman of the PAEC, mentioned, rather casually, and without any substantial grounds, in 1981, that Pakistan could stage a single test within five years. How he came to this most illogical conclusion in the absence of any un-safeguarded reactor, heavy water plant, fuel fabrication plant and above all, even a trivial reprocessing capacity, is a mystery to all technical people who know something about a nuclear program. Where from was he going to steal irradiated fuel rods and where was he going to get them reprocessed--in imagination, I guess.

8. Propaganda Basis

a. The whole propaganda and vehement opposition to Pakistan's nuclear program was started by the western news media purely on presumptuous and baseless apprehensions. The order for the Reprocessing Plant, placed on ill-advice, and without any logical reasoning either for a peaceful power program (or for even a weapons program), gave the western countries and India an excuse to mount a propaganda campaign unseen before. We played straight in their hand as we had no reactors, no fuel to justify the economics of such a plant. The refusal by us to accept a coprocessing plant which gives a mixture of uranium and plutonium oxides usable as fuel in reactors confirmed the doubt that we were interested solely in reprocessing Pu-239 for weapons purpose. Certain highly emotional statements of the late Prime Minister, Mr Bhutto, are used to justify this propaganda against us. The two most frequent statements quoted are:

(1) "If India builds the bomb, we will eat grass or leaves, even go hungry. But we will get one of our own. We have no alternative." (1965)

(2) "We know that Israel and South Africa have full nuclear capability. The Christian, Jewish and Hindu civilization have this capability. The Communist powers also possess it. Only the Islamic civilization was without it, but that position was about to change." (1979)

A casual statement made by President Gen Zia-ul-Haq, also drew some criticism and added some oil to the fire. The statement was quite hypothetical as is clear from the actual wording given below:

"China, India, USSR and Israel in the Middle East possess the atomic arms. No Muslim country has any. If Pakistan had such a weapon, it would reinforce the power of the Muslim World." (1978)

b. The propaganda against Pakistan's peaceful nuclear program got at its peak with the publication of a news-item in Nucleonics Week in October 1978 that Pakistan may be using the centrifuge route to nuclear weapons. Then the ZDF (Second German TV Network) broadcast a program by Gort Lowenthal, a Jew, accusing Pakistan of making an Islamic Bomb. This was followed by prominent articles in "The 8 Days', Sunday Observer (London)", "Der Spiegel (W. Germany)", "Financial Times (London)" which were full of concocted and false stories. That terrorist and murderer of innocent women and children at Sabra and Shatilla refugee camp, Menachen Begin (a real meshagennah), had even the cheek to protest to the Dutch Prime Minister about Dr Khan's employment with FDO. Now the real storm burst. The BBC Panorama film, "Project 706--The Islamic Bomb" and the book named "The Islamic Bomb" by Weissman and Krosney were produced and given the widest possible, world-wide publicity through Jewish-controlled news media. Dr Khan was now the Satan, the Evil-doer, the father of the Islamic Bomb.

The Government of Pakistan, unfortunately, unwillingly contributed to this controversy. First it denied the existence of Dr Khan and then it was accepted that Dr Khan was engaged on an innocuous work. People are not that stupid. Once they came to know of the educational background and technical competence of Dr Khan, they immediately recognised that he was a top class nuclear scientist and Pakistan had the most appropriate man at the right place. Things started moving fast and finally on 06 Dec 1981 President Gen Zia-ul-Haq in an interview to "Sunday Magazine, Calcutta," confirmed that Pakistan had established a Uranium Enrichment Centrifuge Facility. It was for peaceful purposes. he said.

The prosecution and conviction of Dr A.Q. Khan by an Amsterdam Court on the most flimsy grounds of writing a letter from Pakistan to an old colleague requesting for some innocuous information about some chemicals/chemical process hit the headlines of the world news-papers. Naturally, Pakistani news-papers and public reacted sharply at this atrocity and details about Dr Khan and his herculean task came to light. The press wanted to know more. In order to suppress wild guessing and wrong reporting, Dr Khan gave a lengthy interview to Mr Tariq Warsi of the widely circulated national Daily

Nawa-i-Waqt (Voice of the Time), in which the usually soft-spoken and evasive Dr Khan put the record straight. He said Pakistan's nuclear program was solely for peaceful purposes but that Pakistan had broken the monopoly of the western world in the enrichment field. He also emphasized that Pakistan had left India behind by many years and his team was quite competent to make a nuclear bomb, if the President, forced by the danger to Pakistan's existence, integrity and sovereignty gave his team the assignment to make one. Again, the world news media misinterpreted this and distorted the wordings. The President re-emphasized the peaceful nature of Pakistan's nuclear program and confirmed, on return from Moscow on 15.2.84, that Pakistan had the capability of enriching uranium and had joined the select group of 8 or 9 nations. The propaganda against Pakistan's peaceful nuclear program and against Dr Khan's interview and confirmed that he had read the original text of Dr Khan's interview and had found nothing to suggest that Pakistan was engaged in making nuclear weapons. He also confirmed that the western press had distorted Dr Khan's interview.

9. CONCLUSION

In the preceding lines we have explicitly shown that the propaganda mounted against Pakistan's nuclear program by the Western countries, Israel and India is baseless, concocted, biased and imaginary. This is obvious from the following facts:

a. Pakistan could not and has never been in a position to steal or divert spent or irradiated fuel from KANUPP. All IAEA Inspection Reports, up to the latest, have cited no evidence or attempt of diversion. Moreover, KANUPP has never been run to produce Pu-239 with very low degree of contamination of Pu-240. No country, except the United States, has been able to explode a nuclear device with less than 12% Pu-240. Even if one had succeeded in stealing a few elements of irradiated fuel, it would be good enough for nothing. Domestic fuel production rate is trivial and there is no heavy water available without safeguards. Thus no possibility--not even one in a million, exists or has existed for Pakistan to divert or steal spent fuel without being caught 'naked.'

b. The Reprocessing Plant which has been the route cause of all propaganda was ordered on ill advice without any economical or technical justification. It gave the clear impression that Pakistan was interested solely in reprocessing of to-be-stolen fuel from KANUPP to make a nuclear bomb. As the plant was ultimately refused under severe pressure from President Carter and the miniscule, Laboratory-scale, reprocessing unit bought from Belgonuclear has made no hot run as yet, the whole propaganda that Pakistan was diverting spent fuel or reprocessing it was sheer fantasy and an exercise in pure imagination.

c. Pakistan's success in such a record time and at relatively very low cost, to put up an industrial enrichment plant, as disclosed by country's top nuclear scientist and the real father of its nuclear program, should not give rise to any apprehensions to the western world. No doubt, theoretically

it is now possible for Pakistan to enrich uranium to high concentration (if you can enrich 3%, you can enrich 90%, notwithstanding tremendous technical intricacies) and make atomic bombs, both the President of Pakistan and Dr Khan have re-emphasized the peaceful nature of Pakistan's nuclear program and no intention to indulge in weapons production.

d. It is, therefore, obvious that vicious propaganda by Western, Indian and Israeli news media against Pakistan's peaceful nuclear program has no logical basis and is only meant to deprive Pakistan from obtaining expertise in this sophisticated and valuable technology to meet our energy requirements in the coming decades. Pakistan is a peace-loving country and wants to live in peace with her neighbours, but as an independent and sovereign state following her own Islamic ideological principles.

e. The proposal by our President to South Asian countries to declare South Asia as a nuclear weapon-free zone (already approved by the UN) has clearly established our bonafides. To meet the Indian objection to sign the NPT that it was discriminatory against developing and have-not countries, our President's offer to sign a bilateral agreement to inspect each other's nuclear facilities and renounce the nuclear weapons should be accepted as our earnest desire to keep Pakistan and South Asia free from nuclear weapons. The Western, Jewish and Hindu propaganda must come to an end now. We cannot do more.

f. The Western world is full of double standards. Nobody talks about the 100 kg highly enriched uranium stolen from a plant in Apollo, Pa in 1967 and taken to Israel), of the 200 ton yellow cake highjacked on high seas and taken to Israel and now most recently of the 770 kg highly enriched uranium missing from Oak Ridge. But if we start a limited program for our energy needs, we are the black sheep.

g. In spite of all propaganda or pressure, Pakistan must not take unilateral actions to close all options. For the sake of our technological advancement, as well as for our security, we must master all aspects of nuclear technology and should develop full capability as it will bring credit to our nuclear program and stability and peace to the region.

CSO: 5100/4710

PEOPLE SCORED FOR OVERREACTING TO KOEBERG DANGER

Johannesburg THE CITIZEN in English 19 Mar 84 p 9

[Article by Bert van Hees]

[Text]

CAPE TOWN. — The reaction of a University of Cape Town academic to weekend reports that Cape Town's Medical Officer of Health, Dr R Coogan, had sold his house near the Koeberg nuclear power station — partly because he did not want his children growing up in the shadow of the controversial installation — is: "Do not overreact".

Dr Johan Mets of the Department of Community Health at UCT's medical school, said in an interview yesterday residents of Paarl, about 60 km from Cape Town, were exposed to higher levels of radiation from natural sources than people living on the West Coast, including Melkbosstrand."

"People who leave the area due to the potential danger of an excessive release of radio-activity from the station are overreacting," he said.

Dr Mets recently addressed a media conference at the Koeberg power station on the occupational and non-occupatona risks of radiation.

"If I lived in Melkbosstrand, where Dr. Coogan lived and had a house there, with my children going to school there as well, I would not move out for the reason that the house is near the plant.

"There has been a lot of discussion about Koeberg lately and people seem to fear that if there is a release of radio-active gas it will be on an unacceptable level. However, the monitoring system at Koeberg is so well organised — and it has to be — that there is no such risk of this happening without people knowing about it."

Dr. Mets said in France people lived within a mile of a nuclear power station and had done so for years.

According to reports, Dr Coogan was reluctant to talk about his move to the False Bay coast, about 50 km from Koeberg, but admitted that his concern, not only about the remote chance of a nuclear accident, but also about the possible health dangers of legal emissions of radiation into the air, had been fac-

tors in his decision to move.

He made it clear that the other factors were unrelated to Koeberg.

"I think the way to put it is that a long-considered move to a retirement home in Gordon's Bay was finally given impetus by the imminent coming onstream of the power station," he is reported to have said.

Dr Coogan retires in two year's time and has long been respected by the people of Cape Town for his uncompromising statements on public health matters. It was he who forced the national authorities to agree to the drawing up of an emergency plan for the city in the event of a Koeberg disaster.

Until his dramatic last-minute intervention, the plans, co-ordinated by Escom plans, did not include Cape Town.

Points Dr Coogan made at the weekend were:

- His two younger children, daughters of 12 and 15, were still living at home. This had had a big bearing on his decision as he did not consider growing up near a nuclear power station the best environment for them;
- because of the "funny winds" around Koeberg, it could not be assumed that atmospheric radiation from Koeberg would automatically be dissipated over Table Bay.
- Koeberg would be permitted to release certain amounts of radioactive insotopes into the air each year. While there was no scientific proof that such radiation had caused health problems such as cancer, there was a "lot of unease" about it and it had also not been proved perfectly safe; and
- the whole environment of Van Riebeeck Strand had been changed by the building of Koeberg, which he could see from his former house, and the setting up of alarm sirens and other measures to cope with a possible emergency had affected the "sleepy seaside atmosphere" and made the area less desireble to live in.

He would likewise not have been happy to live near a coalfired plant, he is reported as saying.

The regional manager of Escom, which has long been defending the decision to site the plant so close to a huge and densely populated metropolitan area, Mr G F Hellstrom, could not be reached for comment.

CSO: 5100/29

CAPE COUNCIL ISSUES ANTIRADIATION PILLS

Johannesburg THE CITIZEN in English 22 Mar 84 p 10

[Text]

CAPE TOWN. — A "fair number" of people had been issued with potassium iodate tablets — to counter radiation effects should there be a nuclear accident at Koeberg — and more people were expected to come forward for them once Koeberg emergency leaflets reached all Cape Town homes through the post.

Quantities of tablets would soon be distributed to city factories and businesses to become part of standard first-aid supplies.

Emergency plan

This comes a week after the switch-on of the nuclear power station near Melkbosstrand. The pills, made available for voluntary collection from the city council's 25 polyclinics and 27 satellite clinics since early this month, are part ofl the city's Koebert emergency plan.

Cape Town's medical officer of health, Dr Reg Coogan, said: "A fair number of people have been coming in to collect their quota of potassium iodate tablets. There certainly has not been a rush, but we are expecting more people to claim their pills once all the Koeberg emergency leaflets have been posted."

He said each person was allowed one packet of 10 tablets and, in the case of families, a packet for each member.

Dr Coogan urged the public to read the instructions which came with the tablets, but warned people not to take them unless instructed to do so.

Commenting on one instruction which advises people allergic to iodine not to take the pills, Dr Coogan said he felt the effects of radiation on the thyroid gland would outweigh other side effects. - Sapa.

CSO: 5100/30

PROBLEMS OF STORING LOW LEVEL RADIOACTIVE WASTE

Vienna PROFIL in German 20 Feb 84 p 12

[Article by L.P. and M.S.: "Thinking About Storage--Austria's Radioactive Waste Requires Final Disposal Facility"]

[Text] The "stuff" is cast in concrete. The concrete is poured into special vats. The special vats stand in covered sheds. The sheds are surrounded by a dam.

In front of it, patrols the Gendarmerie [state troopers]--also on holidays.

Because the "refuse" is radioactive.

So much so that the face of the mayor of the little Lower Austrian village of Seibersdorf, Paul Renner, darkens the moment the conversation turns to that subject. The "intermediate storage facility" for low-level radioactive to medium-level radioactive waste--decades ago established on the grounds of the Seibersdorf research center--is bursting at the seams.

Said Renner: "That stuff cannot stay here with us to the point where there is no telling when it will end." He refused to extend the permit.

The search for a final disposal facility began with a study project which was commissioned by the Health Ministry for a price of 7 million Schillings and that is to be published during the next several weeks. Here is the explosive question: Where can and should Austria find a final disposal place for its radioactive waste for the next couple of hundred years?

The selection of a site for such a final disposal facility--according to Walter Binner, director of the waste utilization section in Seibersdorf--will "probably be a very ticklish matter in political terms." Even though this does not involve the highly radioactive waste from a nuclear power plant but "only" low-level to medium-level radioactive waste (for example, hospital waste from all over Austria) as well as the so-called "special refuse" (including chemical waste such as dioxin). (The Seibersdorf research reactor and the Prater reactor deliver their waste abroad).

"Of course, theoretically, in addition to such a final disposal facility--if it is built according to all safety criteria--one can even plant bio-vegetables," commented Ministerial Counsellor Wolfgang Pusch of the Health Ministry. "But I do admit that the idea of living near such a final disposal facility is uncomfortable for many people."

The "final storage facility" study project is now going into its final phase; "we are now beginning to narrow down the possible storage sites in regional terms" (Binner).

And this is precisely the phase during which the whole thing begins to become ticklish. Said an expert involved in the project: "The ball, which Mayor Renner returned, will next be flying toward a state governor or the mayor of a community in Austria which is suitably positioned for final storage. The mayor would then have to issue the construction permit. The question is only whether the individual involved will catch the ball."

Two partial studies of the multistage project have already been completed--one to clarify the "nuclear fundamentals," the other one to clarify the "legal aspect." The most ticklish part, the geological part, is being completed first. Said Pusch: "But one can say even now that regions have been found all across the federal states which would be suitable in themselves for this purpose but there are two types of refuse, that is, the kind which after 200-300 years is only so slightly radioactive that one can, after that interval of time, practically dump it on any garbage dump, and the other kind which takes around 1,000 years until its radiation has decayed. In addition we have the special refuse which, in some way, is even more dangerous than the first two types because in its case the danger cannot be delimited in terms of time. That waste must really be once and for all removed from the environment of human beings. While, in other words, one could build a surface deposit facility for low-level radioactive substances and while one does not have to drill a deep tunnel into the earth, it is recommended, in my opinion, to develop an underground disposal facility for that waste which decays only in 1,000 years. Just the way we go hundreds of meters down into the earth with highly radioactive waste."

While surface storage facilities can be erected in any area not threatened with earthquakes, only certain geological formations could be considered for underground storage. Said Pusch: "We are a lucky country because we also have underground storage possibilities, such as granite plateaus. Other countries are certainly also picking salt domes for this. But this is done mostly in those countries which do not have granite. At this time, most experts concentrate their attention on granite."

Here is what that means in political terms:

The politicians in the Waldviertel and Muehlviertel sections, the state governors of Upper Austria and of Lower Austria, in other words, may now get ready to catch this radiating ball.

But the state governments concerned claim "not to have heard anything at all about this whole thing as yet"--although during the last phases of the study project, officials of the particular states, at any rate of Lower Austria, have already been called in. Not to mention a more accurate regional narrowing of the storage possibilities which Pusch would handle in the following manner: "Apart from the fact that it must be geologically correct, there should be good access roads leading there although the site itself must be remote. There has to be energy. It would furthermore be desirable if one could connect such a final disposal facility somewhere. Because we cannot have a situation where the waste is stored in some mountain which is locked in the evening and then everybody goes home. There have to be good surveillance possibilities."

"And, at any rate, it should not, of all places, be located in a tourist center."

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GOVERNMENT URGED TO RAISE SELLAFIELD NUCLEAR ISSUE WITH EC

Dublin IRISH INDEPENDENT in English 2 Mar 84 p 3

[Text]

THE Government is being urged to take the issue of nuclear pollution of the Irish Sea by the Windscale plant to the EEC Commission and if necessary, to the European Court.

In the latter event, we should also withdraw our 'contributing' to Euraton — the body which regulates all nuclear matters in the EEC — it is suggested.

The call for a European probe came yesterday from Mr. John O'Halloran, secretary of the National Co Operative Council, as a new British report disclosed that radioactive waste is still being washed up on the beaches, estuaries and salt marshes surrounding the Cumbria plant.

"If no solution is found within the next month or so, the possibility of further action to clean the beaches, should be considered, "said the U K's National Radiological Protection Board.

"The occurence of a high proportion of tar-like contaminated debris in the last week of a survey inevitably raises the question of whether there is a new source of contaminated items," the report admitted.

If the material was due to further releases from the plant, only elimination of these would be effective.

Yesterday Mr. O'Halloran said that, while the meeting between Tanaiste Mr. Spring and British minister Patrick Jenkins last week was "a commendable gesture", no one in Ireland was going to be able to halt the Windscale scandal unless the matter was taken to Europe.

The Government should bring the matter to the attention of the Commission and demand British clean up the waste problem.

If that failed, we should take it to the Court of Justice and witdraw our contributions to Euratom.

The time had come to stop talking and take serious action.

The Windscale plant was "the nuclear arsenal of the Western world," producing plutonium and other radioactive materials for British military submarines, and warheads, said Mr. O'Halloran. After 200 leaks in the past 30 years, the plant should be closed.

Professor Robert Blackith, professor of zoology at Trinity College, Dublin, also campaigning for closure, was not surprised yesterday at news of the latest nuclear waste discovery.

"The whole system by which the plant is run is totally incompetent. One must expect delayed discoveries of this kind, because the people running the plant do not know what they are doing," he said.

While there was a possibility the civil reprocessing operation at tre plant might be phased out if Britain's Central Electricity Board refused to pay for building of the new Thorp plant at Windscale, it was unlikely a Conservative government would stop the military side of the operation, added Professor Blackith.

And two-thirds of the plutonium being tipped into the Irish Sea in Cumbria came from military reprocessing.

CSO: 5100/7520

BRIEFS

IRELAND AS NUCLEAR TARGET--The Government was accused last night of "virtually inviting" a nuclear attack on this country by allowing telecommunications facilities here to be used by NATO. The claim was made by the Irish Campaign for Nuclear Disarmament which added that the possibility of a direct hit was also increased by Government statements welcoming the NATO nuclear "umbrella." [Text] [Dublin IRISH INDEPENDENT in English 25 Feb 84 p 6]

CSO: 5100/7520

REVIEW OF UK, EUROPEAN PACTS ON FAST-BREEDER REACTORS

London THE DAILY TELEGRAPH in English 14 Jan 84 p 7

[Article by Michael Field and Valerie Elliott]

[Text] Britain's signature on a memorandum associating itself with French and other European work on fast-breeder reactors is the latest move in a 20-year history of multi-lateral and bi-lateral agreements on the development of this new generation of nuclear power stations.

France and Russia agreed in 1966 to regular exchanges of information.

Since then technical and commercial agreements have been concluded between various organisations of the European community working on industrial fast-breeders.

In Europe fast-breeder reactors are situated in France, Italy and West Germany and there is an experimental 250-megawatt fast-breeder reactor based at Dounreay in Scotland.

The French plants are at Marcoule in the Gard, site of the 250-megawatt Phenix system, while the new Super-Phenix, a 1,200 megawatt proto-type fast-breeder is based at Creys-Malville in the Isere.

Italy's 250-megawatt reactor is based at Brasimone and in West Germany the SNR 300 megawatt prototype is at Kalkar in North Rhine-Westphalia.

The countries working on the fast-breeders are linked by several major "nuclear pacts."

'Nuclear Pacts'

The Debene agreement 1968 was between West Germany, Belgium and Holland. They agreed to harmonise their research and development programmes in the fast-breeder field and to jointly build the prototype SNR 300 based in West Germany.

Under one of three linked agreements the electricity boards of the three countries joined by Britain's Central Electricity Generating Board, created a subsidiary pact, the SBK, to build and run the reactor. The others concern research and commercialisation of the reactors.

Agreements signed on July 16, 1971 link Electricite De France, Italy's Ente Nazionale Per L'Energia Elettrica and West Germany's Rheinisches-Westfaelisches Elektrizitaetswerk in efforts to build and run fast-breeder stations.

Then in 1973 and 1974 the Italian and German companies agreed to a minority share in the building costs of France's Super-Phenix.

Further agreements between France and Italy and France and Germany in 1974 and 1977 set out details of the cooperation.

Thus following the 1977 Franco-German agreements and the existing collaboration between France and Italy and Germany, Belgium and Holland, the research and industrial bodies of the five countries had access to a large common fund of knowledge and were able to pool this for further technological progress.

This culminated last August with the formation of a study group on fast-breeders by the five countries. Known as Argo, the group's aim is to probe practical ways of promoting the fast-breeder system in order to contribute to the security of Europe's energy supply.

Britain and France are so far the only countries outside the Eastern bloc using fast-breeder reactor at Dounreay in Scotland has been producing electricity since it opened in 1976. It is fed into the grid system via the North of Scotland Hydro-Electric Board.

In France electricity has been pumped into its national grid by the fast-breeder at Kalkar in North Rhine--Westphalia is expected to begin pumping electricity into the West German grid system next year.

Prototype shelved

Other fast-breeder reactors in India, Italy, Japan and America do not produce electricity commercially.

The world leader in this type of electricity production is Russia which operates a BN 600 megawatt fast-breeder reactor.

However, that will be superseded by France when its Super-Phenix locks into the national grid.

Three months ago the Government announced its intention to build a commercial prototype fast-breeder reactor, but plans have been shelved until the outcome of the Sizewell inquiry is known.

A spokesman for the Atomic Energy Authority said last night that so far the question of possible sites had not been discussed, but when one was chosen there would automatically be a public inquiry.

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UNITED KINGDOM

BRIEFS

SPENT URANIUM HANDLING--Sellafield nuclear reprocessing plant dealt with 321 tonnes of imported spent uranium fuel from seven different countries last year, Mr Giles Shaw, Energy Under Secretary, said yesterday. Uranium came from Japan, Italy, Sweden, Switzerland, Spain, West Germany and the Netherlands, Mr Shaw told Labour's Energy spokesman, Mr Stanley Orme, in a Commons written reply. Mr Orme had asked the Minister how much "nuclear waste" had been imported for reprocessing since 1979 and what were the countries of origin. In his answer, Mr Shaw stressed that spent irradiated nuclear fuel is reprocessed at Sellafield rather than "nuclear waste." Mr Shaw added that British Nuclear Fuel contracts for reprocessing include "options providing for the return to customers of radioactive wastes arising from reprocessing." [Text] [London THE DAILY TELEGRAPH in English 6 Mar 84 p 10]

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